TIFFT MARSH INVASIVE SPECIES ACTION PLAN

DRAFT
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TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Study Area 1
1.2 Background 1

2.0 GOALS AND OBJECTIVES OF THE INVASIVE SPECIES CONTROL HIP 4
2.1 Adaptive Management 4

3.0 HISTORICAL CONDITION 5

4.0 EXISTING CONDITIONS 8
4.1 Plant Resources and Natural Communities 8
4.2 Cover Type Mapping 12
4.3 Monitoring Plots 14

5.0 INVASIVE SPECIES INFORMATION 18

6.0 PRIORITIZATION 19

7.0 CONTROL METHODS 25
7.1 Common Reed 25
7.1.1 Mechanical 25
7.1.2 Chemical 30

8.0 SPECIAL CONCERNS 35

9.0 RECOMMENDED CONTROL METHODS 37
9.1 Overall Approach 37
9.2 Recommend Treatment Options 40
9.2.1 Dense Stands 41
9.2.2 Medium Density Stand Approach 45
9.2.3 Low Density Stand Approach 46
9.2.4 Schedule 48

10.0 MONITORING 49
10.2 Annual Monitoring 49
10.3 Five Year Monitoring 50

11.0 LITERATURE CITED 51

LIST OF FIGURES

Figure 1-1: Tifft Preserve Site Location Map 3
Figure 4.3-1: Tifft Fixed Sample Plot Locations 16
Figure 6-1: Tifft Marsh Invasive Species Group Ranking 24

Figure 9.1-1: Common Reed Management Flow Chart 39
Appendix B. Tifft Cover Type Index Map 56
Appendix B. Tifft Cover Type Sheet 1 of 11 57
Appendix B. Tifft Cover Type Sheet 2 of 11 58
Appendix B. Tifft Cover Type Sheet 3 of 11 59
Appendix B. Tifft Cover Type Sheet 4 of 11 60
Appendix B. Tifft Cover Type Sheet 5 of 11 61
Appendix B. Tifft Cover Type Sheet 6 of 11 62
Appendix B. Tifft Cover Type Sheet 7 of 11 63
Appendix B. Tifft Cover Type Sheet 8 of 11 64
Appendix B. Tifft Cover Type Sheet 9 of 11 65
Appendix B. Tifft Cover Type Sheet 10 of 11 66
Appendix B. Tifft Cover Type Sheet 11 of 11 67

LIST OF TABLES

Table 4.2-1: Cover Types Identified During Cover Type Mapping 12
Table 4.2-2: Cover Types Mapped Within Tifft Study Area 13
Table 4.3-1: Areal Coverage Classes for Vegetation Within Sample Plots 15
Table 4.3-2: Tifft Sample Plots 17
Table 6-1: Rankings Used For Individual Stand Prioritization 21
Table 7.1-1: Potential Pros and Cons of Covering Methods 26
Table 7.1-2: Potential Pros and Cons of Hand Pulling Methods 27
Table 7.1-3: Potential Pros and Cons for Cutting Methods 28
Table 7.1-4: Potential Pros and Cons of Burning 29
Table 7.1-5: Potential Pros and Cons for Water Level Management 29
Table 7.1-6: Potential Pros and Cons of Stem Injection/Clip and Drip Methods 31
Table 7.1-7: Potential Pros and Cons of Hand Swiping Method 31
Table 7.1-8: Potential Pros and Cons for Backpack Herbicide Application 32
Table 7.1-9: Potential Pros and Cons to Wick/Dauber Application 33
Table 7.1-10 Potential Pros and Cons of Boom Spray Herbicide Application Methods 34
Table 7.1-11: Potential Pros and Cons for Aerial Application Methods 34
Table 9.2.1-2: Potential Plant Species for use in Planting Plans 44
Table 9.2.4-1: Treatment Schedule Based on Stand Type * 48

LIST OF APPENDICES

Appendix A: Winter Survey Report 54
Appendix B: Tifft Cover Type Mapping 55
Appendix C: Invasive Species Info 68
Appendix D: Survey Data Sheets 74
Appendix E: Prioritization Matrix 96

1.0 INTRODUCTION

The New York Power Authority (NYPA) is undertaking several habitat improvement projects (HIPs) as part of the Niagara Power Project Comprehensive Relicensing Settlement Agreement. One of these HIPs involves the control of invasive wetland plants within the Tifft Marsh (Tifft or Marsh) (Figure 1-1). This Invasive Species Action Plan is based on inventory work conducted during the winter and summer of 2008, and research into potential control methods. This plan serves to outline management measures and implementation strategies to control and monitor invasive wetland species in targeted areas to promote the growth of functionally valuable wetlands characterized by a diverse community of native wetland vegetation.

1.1 Study Area

Tifft is operated by the Buffalo Museum of Science on lands leased by the City of Buffalo. The Preserve is located in South Buffalo to the east of the Buffalo Skyway (Route 5) along Fuhrman Boulevard. The area was historically used as a shipping facility and dump until the city was petitioned in the 1970's to turn the area into a nature preserve (Spiering, 2008). Originally the refuge was dedicated to conservation and environmental education using land purchased in 1972, the nature preserve was opened in 1976. Tifft includes a variety of habitats ranging from upland forests dominated by cottonwood to sedge dominated marsh habitats. The Action Plan for Tifft is focused on only the marsh portion of the preserve (Figure 1-1). The marsh area is currently dominated by native species and is the largest remnant wetland in Erie County and functions as an Important Bird Area (IBA defined by the Audubon) and migration stop over point (Spiering, 2008). While the marsh portion of Tifft is the primary area targeted by this Action Plan cover type mapping was completed throughout the entire preserve.

1.2 Background

Within Tifft the primary concern is the invasion of Common reed (*Phragmites australis*). Common reed is a vigorous invader and spreads rapidly via vegetative growth through a vast underground system of rhizomes. While Common reed can reach heights of fifteen feet, the majority of the yearly plant biomass (80%) is contained underground (MDNR, 2008). The

ability of Common reed to spread and out-compete native vegetation for growth medium, water, and light makes it a serious threat to natural ecosystems. Common reed has been controlled through the use of mechanical treatments, but the most effective management efforts utilize herbicide treatment in some form (see Section 7.0).

As discussed in greater detail in Section 3.0, Tifft contains a valuable remnant Broad-leaved Cattail marsh (*Typha latifolia*), and the main objective of this HIP (Section 2.0) is to control and monitor Common reed and to prevent Common reed from overtaking these native marsh areas. The Action Plan that follows presents the most recent advances and techniques in the field of Common reed control. While a number of potential methods for control are reviewed (Section 7.0) specific methods are recommended for use within Tifft (Section 8.0) based on a variety of factors. The control of any invasive community is a challenge and our knowledge of the most effective control techniques is constantly changing. Therefore, this Plan utilizes an adaptive management strategy where treatment and monitoring methods may be modified in order to better achieve stated goals while avoiding unnecessary ecological costs (Section 2.1).

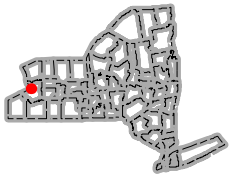
Figure 1.1 Tifft Nature Preserve Site Location Map

N

1 inch = 800 feet

0 400 800 Feet

Figure 1.1
Tifft Preserve Site Location Map



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2.0 GOALS AND OBJECTIVES OF THE INVASIVE SPECIES CONTROL HIP

As identified in the conceptual HIP descriptions included in the Settlement Agreement, the objective of the Invasive Species Control HIP is to:

Control and monitor invasive wetland species in targeted areas to promote the growth of functionally valuable wetlands characterized by a diverse community of native wetland vegetation. It should be noted that the control of exotic species can be difficult and realistic goals have been set with regard to control efforts. Typically reducing further spread and reducing dominance in targeted areas is a reasonable goal; eradication is usually not achievable at the landscape level (NYPA, 2005).

2.1 Adaptive Management

An ecologically-based adaptive management strategy was used as the basis for this invasive species Action Plan in order to meet the stated objectives. The focus of adaptive management is the adjustment of management techniques over time in response to monitoring and information gathering in order to reach management goals.

The initial steps of the Action Plan are specifically designed to monitor the effectiveness of control techniques and assess their success at a small scale before moving forward and beginning to treat additional sites on a larger scale (the specific Action Plan steps are detailed in 9.0). The Action Plan uses a "phased" approach where the highest priority sites are treated first. Since invasive species can always re-invade controlled areas, treated areas will regularly be monitored to assess effectiveness and the need for spot applications. As such, even when the second phase is in progress, the monitoring and spot treatments (as necessary) will still include the Phase 1 areas. Adjustments to control techniques will be made according to what is learned during treatments.

A thorough review of existing techniques for Common reed control was conducted and, based on these findings, recommended control methods were selected for use within Tifft. Deviation from these methods is an option, within an adaptive management framework, if the assessment of effectiveness monitoring suggests a change in technique is merited.

3.0 HISTORICAL CONDITION

The history of Tifft Marsh is varied, due primarily to its location within a highly industrial section of Buffalo that was important to shipping and manufacturing. Spiering (2008) describes Tifft's history:

> *The land which is now Tifft Nature Preserve was formerly part of an extensive flood plain and wetland complex surrounding the mouth of the Buffalo River. This area extended along the south shore of Lake Erie from present day downtown Buffalo to the City of Lackawanna. Before 1850, a drainage ditch was constructed through the center of the property to the Buffalo River. This ditch drained the western half of the property, but the land was periodically flooded by wind-driven water from Lake Erie until the south harbor breakwater was built in 1903. The area underwent dramatic changes as Buffalo became an important center for shipping and commerce at the end of the 19th century. The 75-acre (30-hectare) cattail marsh on the east side of the preserve is the only remnant plant community remaining on the preserve.*
>
> *During the late 1800's, three canals were dredged on the west side of the preserve, then known as Tifft Farm, including the City Ship Canal which connected the canals to Lake Erie at the mouth of the Buffalo River. Coal and timber were important commodities shipped to the site and railroad lines traversed the property to connect the canals to inland destinations. Buffalo's importance as a major transshipment center was coming to an end in the first half of the 1900's, and the steel industry dominated business in the area. During this time, the property had several owners including Lehigh Valley Railroad, the City of Buffalo, and Republic Steel. All of these owners used it as a dump site for slag, fly ash, foundry sand, harbor dredge spoils, and refuse. Portions of the canals,*

> *including the connection to Lake Erie via the City Ship Canal, were filled with these materials.*
>
> *In the early 1970's, the city again purchased the land and had plans to relocate refuse to the property from a proposed sewage treatment plant site on Squaw Island. Concerned citizens did not want to see the remaining wildlife and habitat lost and successfully petitioned the city to restrict the refuse transfer to the southwest corner of the property and establish a nature preserve on the site. Since 1975, the site has been managed as a nature preserve, and in 1982 the Buffalo Society of Natural Sciences took charge of the city-owned property which it continues to manage to this day as its "living collection" for scientific education and research. Following a plan completed in 1975, trails and boardwalks were constructed and the Makowski Visitor Center was built in 1978. An Environmental Education Center was later added to enhance the public's enjoyment of the preserve and increase educational programming potential* (4).

Resulting from the preserves' mission of environmental education a number of surveys related to vegetation within the marsh (and surrounding uplands) have taken place. Surveys conducted from 1982-1988 identified Broad-leaved cattail as abundant and more common than Narrow-leaved cattail (*Typha angustifolia*). Common reed was noted as being infrequent, but in several dense colonies. Additionally a variety of Sedges (*Carex spp*), Rushes (*Juncus spp*), and Bugleweeds (*Lycopus spp*) were identified along with Field mint (*Mentha arvensis*), Marsh skullcap (*Scutellaria galericulata*), and Bittersweet nightshade (*Solanum dulcamara*) (Klips et al, 1993). Vegetation survey information was also collected in 1980 (Emmanuele) and 1995.

Further activities within Tifft include the excavation of channels and pools in order to increase habitat for wadding birds in 1999. In 2006 the marsh was further enhanced by the construction of 5 shallow ponds with islands in the center of each. These islands were vegetated with Button bush (*Cephalanthus occidentalis*) and Burreed (*Sparganium* sp.). The channels and ponds were designed to increase habitat diversity within the cattail marsh in order to enhance habitat for birds within the

marsh (Spiering, 2008). In some places, Common reed is beginning to invade areas of spoil associated with the excavation, as a number of small stands (only a few stems) were observed along spoil piles during the cover type mapping.

4.0 EXISTING CONDITIONS

4.1 Plant Resources and Natural Communities

Table 4.1-1 lists plants observed within monitoring plots (Section 4.3) specifically as well as species observed within the marsh generally. Global and state rarity rankings were included for each species. The survey did not identify any threatened or endangered plant species. The rarity rankings, which are related to the conservation status of a species or ecosystem, are designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global), N = National, and S = Subnational or State). The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable
4 = apparently secure
5 = secure

For example, G1 would indicate that a species is critically imperiled across its entire range (i.e., globally). In this sense the species as a whole is regarded as being at very high risk of extinction. A rank of S3 would indicate the species is vulnerable and at moderate risk within a particular state or province, even though it may be more secure elsewhere (Natureserve 2009).

A search of the New York Natural Heritage Program (NYNHP) did not identify any threatened or endangered plants within the study area. Giant St. Johnswort (*Hypericum ascyron*) which appears on the Natural Heritage Program's watch list was identified within the marsh. The NYNHP did identify a single plant that was observed in the vicinity, golden dock (*Rumex maritimus*). Golden dock (*Rumexmaritimus*), which is listed as State Endangered, is noted as occurring within the vicinity of Tifft marsh, based on an observation from 1898. Given that the habitat for this species is generally brackish or along shores of salt marshes it is not expected

within Tifft marsh. While not identified during the search of the NYNHP database, Southern Blue flag (*Iris virginica* var. *shrevei*), is known to occur in the area and may potentially occur within the marsh. Southern Blue flag is State endangered in New York (S1). Pre-treatment plant surveys (Section 10.0) will ensure that this and any other potentially occurring rare species are not present prior to treatment. Additionally the NYNHP identified Black tern as being sighted within the marsh in the late 1970's. The Midland clubtail (*Gomphus fraternus*), and American burying beetle (*Nicrophorus americanus*) were also identified as occurring within the vicinity of the marsh. The Midland clubtail is a dragonfly often found along wind-swept lakes and along large rivers; this observation was noted for Buffalo in 1906. Little is know regarding the habitat preference of the American burying beetle, but wetlands offer little in the form of usable habitat for this species. The observation is noted for Buffalo with no date provided. Based on available information regarding habitat and life history, the Midland clubtail and American burying beetle are not likely to occur within the study area. Black tern, sedge wren, Northern harrier, and other RTE species will be the focus of the pre-treatment survey for RTE plants and wildlife (Section 10.0).

Table 4.1-1: Tifft Plant List

COMMON NAME	SCIENTIFIC NAME	Rarity (Global/State)
Red maple	Acer rubrum	G5/S5
Garlic mustard	Alliaria petiolata	Exotic
Speckled alder	Alnus incana	G5/SNR
Swamp milkweed	Asclepias incarnata	G5/S5
Aster sp.	Aster sp.	-
False nettle	Boehmeria cylindrica	G5/S5
Canada bluejoint	Calamogrostis canadensis	G5/SNR
Carex sp.	Carex sp.	-
Button bush	Cephalanthus occidentalis	G5/S5
Canada thistle	Cirsium arvense	GNR/SNR
Hedge bind weed	Convolvulus sepium	G5/SNR
Silky dogwood	Cornus amomum	G5/SNR
Red oiser dogwood	Cornus stolonifera	G5/SNR
Queen Annes' lace	Daucus carota	G5/SNR
Teasle	Dipsacus sylvestris	Exotic
Spike rush	Eleocharis sp.	-
Hairy willow herb	Epilobium hirsutum	Exotic
Joe-pyed weed	Eupatorium maculatum	G5/SNR
White boneset	Eupatorium perfoliatum	G5/S5

Table 4.1-1: Tifft Plant List (Cont'd)		
COMMON NAME	**SCIENTIFIC NAME**	**Rarity (Global/State)**
Japanese knotweed	Falopia japonica	Exotic
Green ash	Fraxinus pennsylvanica	G5/S5
Rough bedstraw	Galium asprellium	G5/S5
Bedstraw species	Galium sp.	-
Avens species	Geum sp.	-
Great St. johnswort	Hypericum ascyron	G4/S3*
Marsh St. johnswort	Hypericum virginicum	G5/S5
Jewel weed	Impatiens capensis	G5/S5
Soft rush	Juncus effusus	G5/SNR
Rice cut grass	Leersia oryzoides	G5/S5
Swamp privet	Ligustrum vulgare	Exotic
Honeysuckle	Lonicera sp.	-
Marsh purslane	Ludwigia palustris	G5/S5
Bugleweed species	Lycopus sp.	-
Purple loosestrife	Lythrum salicaria	Exotic
Wild mint	Mentha arvensis	G5/SNR
Monkey flower	Mimulus ringens	G5/SNR
Water lily	Nuphar sp.	-
Sensitive fern	Onoclea sensibilis	G5/S5
Virginia creeper	Parthenocissus quinquefolia	G5/S5
Common reed	Phragmites australis	Exotic
Clear weed	Pilea pumila	G5/S5
Grass species	Poa sp.	-
Ladies thumb	Polygonum persicaria	G4/S5
Tearthumb	Polygonum sagittatum	G5/S5
Polygonum sp.	Polygonum sp.	-
Cottonwood	Populus deltoides	G5/S5
Pondweed sp.	Potamogeton sp	-
Rumex sp.	Rumex sp.	-
Arrowhead	Sagittaria latifolia	G5/S5
Willow sp.	Salix sp.	-
Soft stem bulrush	Schoenoplectus tabernaemontani	G5/S5
Dark green bulrush	Scirpus atrovirens	G5/S5
Scirpus sp	Scirpus sp.	-
Wool grass	Scripus cyperinus	G5/S5
Marsh skullcap	Scutellaria epilobiifolia	G5/S5
Water parsnip	Sium suave	G5/S5
Burreed	Soarganium sp.	-
Bittersweet nightshade	Solanum dulcamara	Exotic

Table 4.1-1: Tifft Plant List (Cont'd)

COMMON NAME	SCIENTIFIC NAME	Rarity (Global/State)
Lance-leaved goldenrod	Solidago graminifolia	G5/S5
Goldenrod sp	Solidago sp.	-
Field sow thistle	Sonchus arvensis	Exotic
Meadow sweet	Spiraea latifolia	G5/S5
Steeplebush	Spiraea tomentosa	G5/SNR
Common hedge nettle	Stachys tenuifolia	G5/S4
Marsh fern	Thelyptris palustris	G5/S5
Narrow-leaved cattial	Typha angustifolia	G5/S5
Broad-leaved cattail	Typha latifolia	G5/S5
Stinging nettle	Urtica diocia	G5/S5
Moth mullien	Verbascum blattaria	GNR/SNR
Mullien	Verbascum thapsus	GNR/SNR
Blue vervain	Verbena hastata	G5/SNR
Viburnum sp.	Viburnum sp.	-
Wild raisin	Viburnum cassinoides	G5/S5
Northern arrowwood	Viburnum recognitum	G4/S5

*Appears on the New York Natural Heritage Program Watch List

Three natural communities occur within the marsh portion of Study area. These natural communities are identified by the NYNHP as Deep Emergent Marsh, Shallow Emergent Marsh, and Shrub Swamp. Deep emergent marsh occurs on mineral soils or fine-grained organic soils (muck or well-decomposed peat); the substrate is flooded by waters that are not subject to violent wave action. Water depths can range from 6 in to 6.6 ft (15 cm to 2 m); water levels may fluctuate seasonally, but the substrate is rarely dry, and there is usually standing water in the fall. Shallow emergent marsh occurs on mineral soil or deep muck soils (rather than true peat), that are permanently saturated and seasonally flooded. This marsh is better drained than a deep emergent marsh; water depths may range from 6 in to 3.3 ft (15 cm to 1 m) during flood stages, but the water level usually drops by mid to late summer and the substrate is exposed during an average year. Shrub swamps are an inland wetland dominated by tall shrubs that occurs along the shore of a lake or river, in a wet depression or valley not associated with lakes, or as a transition zone between a marsh, fen, or bog and a swamp or upland community. The substrate is usually mineral soil or muck (Edinger, 2002). All of the communities identified within the study area are ranked G5/S5.

4.2 Cover Type Mapping

Two surveys were completed within Tifft; initial cover type mapping was completed during a winter survey that took place over several days in January 2008. The majority of the Common reed patches within Tifft were mapped during this winter survey (NYPA, 2008). The second visit, completed in July 2008, identified additional cover types not mapped during the winter, establish fixed monitoring plots, and located additional (if any) stands of invasive species missed during the winter survey. Work was completed by a team of scientists over the week of July 14th. Based on this work a basic cover type classification scheme was developed and is shown in Table 4.2-1. Appendix B contains cover type mapping for the Tifft study area based on both the winter and summer observations.

Table 4.2-1: Cover Types Identified During Cover Type Mapping

Cover Type	Description
Common Reed Dominated	> 75% Common reed
Mixed Species Common Reed Present	Mixed native species with common reed present
Japanese Knotweed	> 75% Japanese knotweed
Cattail Dominated	>75% Cattail, < 25% native non-invasive cover
Mixed Species Marsh Dominated by	>75% Native mixed non-invasive cover
Open Water	>50% Open water
Scrub-Shrub	Various species, dominated by shrubs
Forested	Forested community
Upland Shrubs/Disturbed Soils	Shrubs and areas of cut/fill or debris
Mowed	Manicured or developed land
Other	Boardwalks, parking areas, etc.

Using methods described in the winter survey report (NYPA, 2008), field crews surveyed Tifft to map vegetation according to Table 4.2-1. In addition, field maps with aerial imagery and cover type mapping were used to sketch or note approximate changes to cover types in the field. Also any cover types that were previously missed, including invasive species (Common reed, Japanese knotweed, etc) were mapped if located. All mapping of invasive species stands was completed on the ground using sub-meter accurate GPS.

Results from the summer survey were used to refine data collected during the initial winter cover type mapping, and summary of the results is presented in Table 4.2-2. Overall,

Cattail Dominated Marsh is the most dominant marsh cover type accounting for 33.0 acres (44.7%) of the survey area. *Open Water* occupies 25.7 acres (34.9%) of the total survey area. *Common Reed Dominated Marsh* accounts for 8.8 acres (11.9%), *Mixed Species Common Reed Present* accounts for 2.3 acres (3.1%), *Mixed Species Dominated by Natives* accounts for 0.9 acres (1.2%). The remaining 3 acres (4.1%) include *Mowed*, *Scrub-shrub*, and *Other* (paths, walkways, etc).

Invasive cover types identified during the survey account for 11.1 acres or 15.0% of the total wetland area (Table 4.2-2). Within Tifft, Common reed was the primary invasive species present. Reed canary-grass (*Phalaris arundinacea*), Purple loosestrife, Japanese knotweed, and other species (Appendix C) occurred at very low densities. Generally Japanese knotweed and other upland or wetland edge invasive species occurred outside of the marsh study area. Common reed was present in all of the 57 invasive polygons.

Table 4.2-2: Cover Types Mapped Within Tifft Study Area

Cover Type	Mapped Polygons	Square Feet	Acres	Percent of Marsh
Cattial Dominated Marsh	19	1,436,199	33.0	44.7
Open Water	1	1,119,488	25.7	34.9
Common Reed Dominated Marsh	**18**	**383,328**	**8.8**	**11.9**
Mixed Species Common Reed Present	**39**	**101,495**	**2.3**	**3.1**
Scrub-Shrub	5	58,405	1.3	1.8
Mixed Species Marsh Dominated by Natives	9	39,204	0.9	1.2
Mowed	4	51,697	1.2	1.6
Other	4	23,697	0.5	0.7
Total	**99**	**3,213,513**	**73.7**	**100.0**

The Tifft study area is dominated primarily by extensive stands of Cattail. Other species were present to a lesser degree within these Cattail dominated habitats, and included Bugleweed (*Lycopus sp*), Marsh purslane (*Ludwigia palustris*), Arrowhead (*Sagittaria latifolia*), Button bush (*Cephalanthus occidentalis*), and Polygonum spp. Drier microsites located along side cast from the excavated channels occasionally included Canada thistle (*Cirsium arvense*) and Nettles (*Urtica diocia*).

In stands of Mixed Species Common Reed Present, reed was primarily mixed with Broad-leaved cattail and occasionally False nettle (*Boehmeria cylindrica*), Jewelweed (*Impatiens capensis*), and Skullcap (*Scutellaria*). In stands dominated by Common reed, native vegetation was present, and commonly included Narrow and Broad-leaved Cattail, False nettle and Jewelweed in limited densities.

Some areas of the study area were dominated by Burreed, these areas included a small shallow island located near the southern viewing blind within the southern end of the study area and a larger area further south. The Burreed dominated marsh is most prominent in the southern-most pool in the marsh and where a dense stand occupies the shallow edge of this pool. This Burreed stand borders scrub-shrub which transitions upslope toward an area of forested wetland with Common reed present in the understory. Portions of the scrub-shrub community in this southern pool are bordered by an extensive stand of Japanese knotweed. Currently the knotweed occupies the transition zone between the marsh and upland.

Within the constructed channels are four shallow islands which were created during the channel excavation. During the survey these islands were submerged with approximately 6-12" of water. These islands are vegetated primarily with Arrowhead, Burreed, Smart weeds, and Button bush. Button bush plantings showed some growth, but were not as vigorous as the herbaceous species. Invasive species on these islands were limited and only Purple loosestrife was observed in limited densities.

4.3 Monitoring Plots

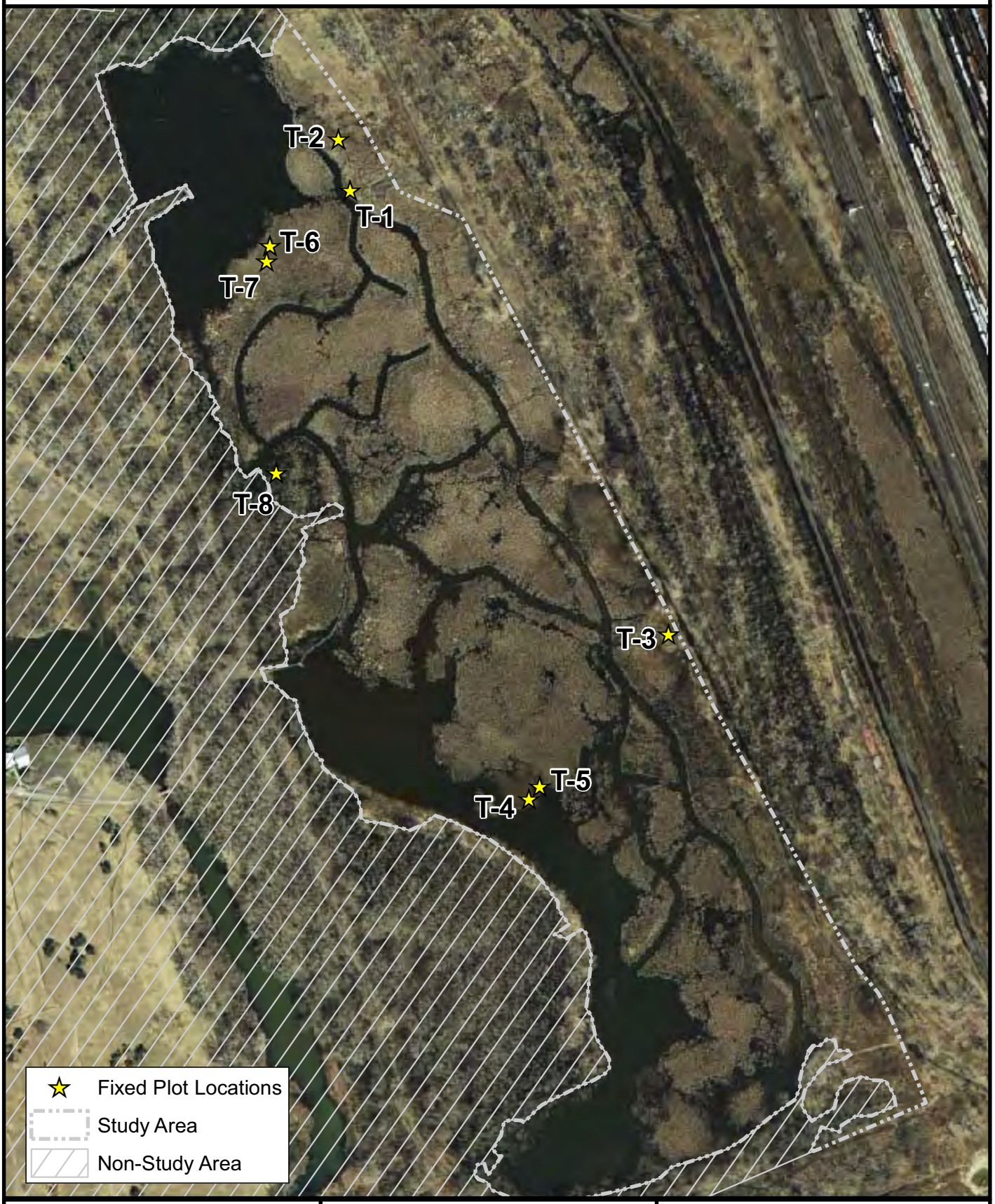
In order to further document the baseline condition and allow for future effectiveness monitoring, including documentation of the results of control efforts, eight permanent vegetation sample plots were established. Sample plot locations were randomly located within predetermined cover type polygons. Plots were located within invasive cover types (*Mixed Species Common Reed Present* and *Common Reed Dominated*). A permanent pin (rebar) was installed in the southeast corner of each plot and marked with marking paint. Plot locations were also marked with the Trimble GEO-XH GPS. A pre-constructed PVC 1m sq plot frame was used to delineate the monitoring plot with the corner of the frame placed over the driven plot stake. Figure 4.3-1 shows the location of the sample plots. At each sample plot, vegetation was identified to species; the percent of area covered by each species was also recorded as an areal cover class (Table 4.3-1). For sample plots with invasive

Common reed (or other invasive species) stem counts were completed. Photographs of each monitoring plot were taken looking from the southeastern pin. Copies of monitoring data sheets and plot photos are included as Appendix D.

Table 4.3-1: Areal Coverage Classes for Vegetation Within Sample Plots

PERCENT OF AREA COVERED	MID POINT (Areal Cover Class)
1-5%	3
6-15%	10.5
16-25%	20.5
26-50%	38
51-75%	63
76-95%	85.5
96-100%	98

Figure 4.3-1 Tifft Fixed Sample Plot Locations



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1 inch = 400 feet

0 200 400 Feet

Figure 4.3-1
Tifft Fixed Sample
Plot Locations

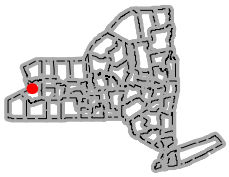

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Table 4.3-2 identifies the eight sample plots, including the mapped cover type where they occur. Common reed was the only invasive species identified within the sample plots. Purple loosestrife was present within the marsh but was not identified within any of the sample plots.

Table 4.3-2: Tifft Sample Plots

PLOT NUMBER	COVER TYPE
T-1	Mixed Species Common Reed Present
T-2	Common Reed Dominated
T-3	Common Reed Dominated
T-4	Common Reed Dominated
T-5	Mixed Species Common Reed Present
T-6	Mixed Species Common Reed Present
T-7	Common Reed Dominated
T-8	Common Reed Dominated

5.0 INVASIVE SPECIES INFORMATION

Currently a number of invasive species are present within the Tifft Preserve, including Common reed, Purple loosestrife, and Narrow-leaved cattail. Additionally a number of identified invasive species such as Buckthorn and Japanese knotweed are restricted to the upland environment and are not a threat to the native marsh areas. The priority species for control measures is Common reed. More detailed species information is presented for some of the more common species present in Tifft marsh in Appendix C.

Common reed currently poses the greatest threat to the structure and function of Tifft Marsh relative to other invasive species (Section 3.0 and Section 4.0). As such, Common reed was identified as the highest priority species for control measures at Tifft.

Purple loosestrife is present in the marsh and is a wetland species capable of inhabiting the native marsh cover types at Tifft. Because Purple loosestrife is not widespread in the marsh and given that the Buffalo Museum of Science (BMS) has pursued biological control releasing beetles (*Galerucella)* in the area previously, this species is no longer considered a significant threat and is ranked as a low priority. Beetles were released in the marsh area at least twice during the period 2002-2005. The BMS obtained the beetles from Cornell and had students raise them. There are no detailed records of quantities or precise release areas, however there was evidence as recently as 2008 of heavy beetle feeding activity throughout the preserve where purple loosestrife occurs (David Spiering personal communication, April 2, 2009). Broad-leaved Cattails have been a dominant fixture as the marsh portion of Tifft has been left largely in its original condition (Spiering, 2008). While Broad-leaved cattail may form dense colonies, these Cattails provide habitat value and are not viewed by the NYSDEC and other stakeholders as being as significant a threat as Common reed (NYSDEC, personal communication, ESC meeting, December 2007). Japanese knotweed is present in large stands primarily in areas away from the Marsh. While this invasive species is of concern in New York it is not a threat to the existing marsh as it tends to prefer upland or wetland edge habitats. Japanese knotweed was, therefore, not identified as a priority species within Tifft Marsh.

Additional species, such as garlic mustard and the invasive bush honeysuckles, and others are also restricted to the upland environment and are not a threat to the native marsh areas. Since an objective of this HIP is to protect valuable native wetland habitat types from invasives, these upland species were considered to be a low priority for control.

6.0 PRIORITIZATION

Fifty seven stands of invasive Common reed were located within the marsh. Each of these stands was given a unique Site Number (1 through 57) to aid in sorting and data analysis. In order to efficiently control these stands of invasive species an in-depth decision framework was developed. This framework uses a basic ranking scheme in order to sort stands based on a number of factors affecting the efficiency and relative benefits of control at specific locations. Because the variables that were used are mostly independent (*i.e.*, accessibility is independent of stand density) the values were not weighted. One exception is the "potential to expand" and the "adjacent to sensitive habitat" variables. In order to focus on patches that have the highest potential to expand, the variable for expansion potential includes four ranking categories (0-3) to allow a lower priority for patches adjacent to walkways, deep channels, or other obstructions to expansion. Remaining variables have three ranking categories. This ranking framework was used as a tool for selecting a phased approach for the control of stands within Tifft and is described in detail below.

Prioritization was completed for Common reed only. Additional invasive species within the marsh are not considered within this prioritization framework, as they are currently not actively invading the marsh. In order to ensure that a phased implementation would address the highest priority sites first, each of the 57 stands containing Common reed in Tifft marsh was evaluated and a basic method to prioritize them for treatment was developed. First, a number of key factors were independently rated using the numerical assignments indicated in Table 6-1. The system relied on three values (0, 1, or 2) for each measured variable for size, accessibility, areal cover, and adjacency to sensitive habitat. Lower values result in a higher priority ranking and higher values result in a lower priority ranking (for example, stands with a greater potential to expand were assigned a 0 for that variable). For the expansion variable four values were used (0-3). Stands with a very low possibility for expansion (*i.e.*, stands adjacent to deep channels or

paved walkways) were given a value of 3. This resulted in a slight weighting for the "potential to expand variable." Based on the sum of the individual factors, each stand was given a priority ranking ranging from 0-11. This individual priority rank was used to develop the group prioritization described in detail below.

The decision framework and subsequent rankings were based on field observation as well as GIS analysis of data for each stand. The reasons that particular variables were chosen are outlined later in this section. The following is a brief summary of information used to rank variables for each stand:

- **Size:** Acreages for each stand were calculated within the GIS. The calculated acres were used to rank stands based on the size range presented in Table 6-1.
- **Access:** The accessibility of a given stand was based on proximity to walkways, roads, channels, or uplands. In cases where stands were near or adjacent to walkways, roads or trails access was considered easy (Rank 0). In situations where stands were near channels (for access by boat) or uplands access was considered moderate (Rank 1). For the remaining stands that were isolated (*i.e.*, surrounded by marsh) access was considered not easy (Rank 2).
- **Areal Cover:** Estimates of areal cover were made in the field for each mapped polygon of invasive species. These estimates were used to rank stands based on the information provided in Table 6-1.
- **Potential to Expand:** Expansion potential was based on a number of characteristics specific to each stand. Stands adjacent to mixed native marsh areas have a high probability to expand, expansion risk was considered very high (Rank 0). For stands largely bordering areas of dense cattail (cattail is nearly as competitive as Common reed and may also form dense mono-cultures that result in slower invasion of Common reed), but partially bordering barriers to expansion such as open water or walkways/roads, expansion potential was considered moderate (Rank 1). For stands with more limited potential for expansion (due to longer borders with channels, walkways, dense cattail, etc.) the risk for expansion was considered low (Rank 2). The remaining stands are primarily those isolated

in areas of dense Cattail, bordering open water, or dense shrub/forest and were given a very low chance for expansion (Rank 3).

- **Adjacency to Sensitive Habitat:** Stands were examined within the GIS to determine the adjacency to areas of sensitive native habitat (sedge meadow, Burreed, etc). Areas directly adjacent to these habitats were given high priority (Rank 0). Stands within 100 feet of these areas were given moderate priority (Rank 1). The remaining stands were given a low priority (Rank 2).

As noted above, the first three variables are independent variables whereas the last two (adjacency to sensitive habitat and potential to expand) are dependant. This results in a weighting towards prioritizing stands near mixed native habitat. This was considered to be consistent with the goals and objectives of this HIP (Section 2.0).

Table 6-1: Rankings Used For Individual Stand Prioritization

Size	**Rank**
Large (> 0.50 acres)	2
Medium (0.1 - 0.499 acres)	1
Small (< 0.1 acres)	0
Accessibility	**Rank**
Not easily accessible	2
Moderately accessible	1
Easily Accessible	0
Areal Cover of Common Reed	**Rank**
High (≥ 75%)	2
Moderate (> 30% < 75%)	1
Low (≤ 30%)	0
Potential To Expand	**Rank**
Very Low	3
Low	2
Moderate	1
High	0
Adjacent to Sensitive Habitat	**Rank**
Far from (> 100' from native habitat)	2
Close Proximity (within 100' of native habitat)	1
Adjacent (adjacent to native habitat)	0

The following discussion outlines how ratings were assigned for various factors within the prioritization system. Adjacency to sensitive habitat is an important factor since a primary objective of this HIP is to protect native wetland habitats from Common reed encroachment. Sensitive habitat refers to the "*Mixed Species Marsh Dominated by Natives*" cover type, primarily areas of burreed, arrowhead, and button bush. The majority of these areas are located in the southern extent of the marsh and on the created emergent islands within the channels. In some cases areas of Cattail were considered as sensitive if Common reed stands were small and newly established. This will allow these stands to be targeted before extensive rhizomes become established.

The ability of Common reed to expand is key to the invasion of native habitats, and its use as a key component of the ranking system. This variable was weighted more than the other variables in that: 1) The range of values for this factor was 0-3 instead of 0-2 for other variables, and 2) this variable is not wholly independent because adjacency to sensitive native habitat contributes to expansion potential. Common reed has the potential to quickly overtake areas of native vegetation and out-compete the shade-intolerant native marsh vegetation. Cattail, unlike other native marsh species, is a vigorous competitor itself in marsh habitat and where Common reed shares an interface with Cattail, Common reed will generally only be able to advance slowly. As such, any stand containing Common reed that is surrounded by open water and "*Cattail Dominated Marsh*", for example, should be increasing its size relatively slowly. Significant barriers to expansion included open water, forest, and impervious surfaces like boardwalks and maintained paths to be significant barriers to expansion. In general it makes sense to give priority to those patches that threaten to expand most rapidly.

The size of the stand was considered an important factor in the prioritization because controlling smaller stands of invasives is considered to have a higher level of efficiency than larger stands. Achieving successful control of small stands is assumed to be more likely due in part to the ability to ensure all stems are treated (*i.e.* smaller areas result in fewer total stems to treat). In general, smaller stands are more recently established and their expansion can often still be "nipped in the bud" with less effort; larger stands, on the other hand, are on average more

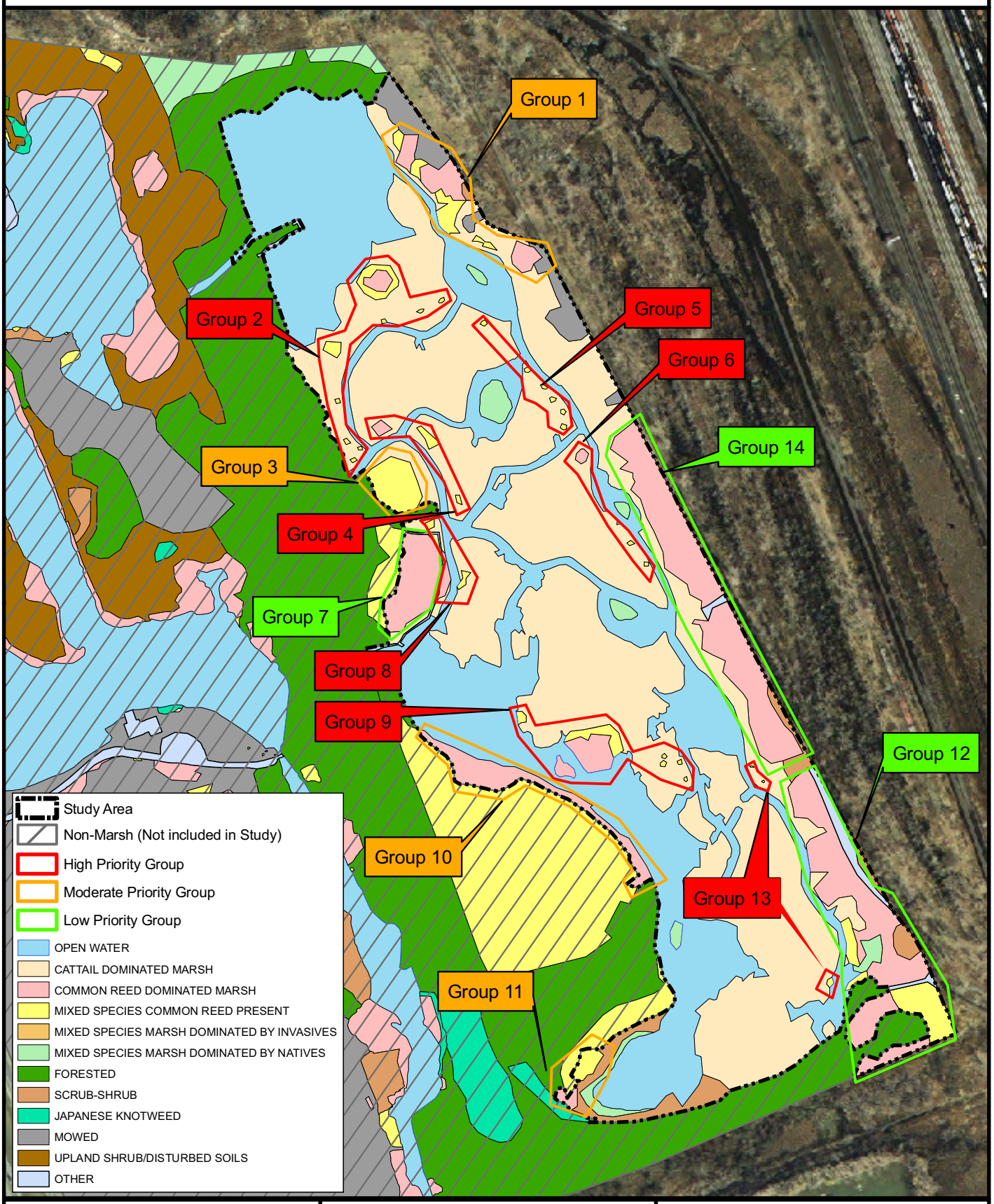
likely to have slowed their expansion by encountering barriers to spread. While the likelihood of successful treatment is not a specific factor used in this prioritization framework, small stands are assumed to have a higher likelihood of success and therefore are given high priority.

In order to efficiently manage the control of the invasive species within Buckhorn Marsh and ensure the highest priority stands are treated, the first step was to prioritize individual stands based on the criteria outlined above. Based on site specific characteristics each individual stand was given a priority rank (Appendix E, Table 1). The second task identified groups of stands that were within close proximity to each other. Once each group was identified the individual stand ranks were averaged to generate the priority score for each of the groups (Appendix E, Table 2). Ranking by groups (Figure 6-1), recognizes that it is more efficient to treat a group of nearby stands at the same time regardless of the individual stand rankings.

The priority ranking of each invasive group was determined using the average of the group's individual stand ranks. The results are shown in Figure 6-1 and Appendix E. Groups with an average priority rank of less than 5 are given highest priority. The high priority groups (2, 4, 5, 6, 8, 9, and 13) include all invasive stands near sensitive habitats and should be treated during Phase 1. Groups with an average rank greater than or equal to 5.0 but less than 8.0 (1, 3, 10, and 11) are considered of moderate priority, and should be targeted during Phase 2. The remaining groups (7, 12, and 14) all have average ranks greater than or equal to 8, and represent the low priority groups. The low priority groups will be addressed only after the successful treatment of higher ranked groups.

This method will allow managers flexibility in planning and execution of control methods within the Marsh. It should be noted that priority groups may not all be completed within a single year (*i.e*. multiple years may be required to sufficiently treat all priority groups). The ranking of these groups simply provides managers with a prioritized list from which to work.

Figure 6.1: Tifft Marsh Invasive Species Group Ranking



N

1 inch = 450 feet

Feet
0 225 450

Figure 6.1
Tifft Marsh Invasive Species Group Ranking

New York Power Authority

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7.0 CONTROL METHODS

An extensive review of current literature related to the control of Common reed was conducted as part of the preparation of this Action Plan. Commonly used control techniques are described below and are similar throughout much of the literature. While methods generally focus on using chemical or mechanical (and sometimes biological) mechanisms for control, the specific approach and the extent to which these methods are used may differ greatly. In some cases, extensive aerial herbicide application is used to treat large areas while smaller areas may be more effectively treated with more targeted chemical or mechanical methods. Each method for the control of an invasive species carries the risk of damaging non-target species, with some methods carrying greater risk than others to the native environment. The best approach to the management of Common reed attempts to balance the environmental impact and the management goals set in place.

7.1 Common Reed

Common reed control methods primarily fall into one of two major categories: Mechanical or Chemical. Currently there is no viable biological control method for Common reed (TNC, 2003). It should be noted that while each method has particular benefits the most successful management plans utilize multiple methods in tandem (MDNR, 2008).

7.1.1 Mechanical

The primary mechanical control methods are covering, mowing, burning, cutting, pulling, or any variety of plant removal based on labor intensive control methods. Pulling is commonly used in conjunction with small hand tools and targets small infestations. Mowing and cutting are generally used in larger infestations targeting the above ground portion of the plant. Mechanical control of Common reed is undertaken with the aim being to eliminate the ability of the plant to photosynthesize which results in an increase in stress leading to the elimination of the plant if repeated frequently enough.

Covering: Covering stands of Common reed with black plastic can be effective in small stands (i.e., <100 plants), with low to medium density (1 to 75% areal coverage). Plants die off within 3 to 10 days, depending on sun exposure, but prolonged control is necessary and stems must be cut prior to covering (TNC, 2003). This method can be labor intensive, typically requires other control measures to achieve success, and its use in combination with herbicide application does not significantly improve the success rate of herbicide control. Also, great attention must be paid to ensuring that absolutely no culms extend past the cover that would allow plants beneath the plastic to continue to photosynthesize (TNC, 2003). Potential benefits and draw-backs to this method are presented in Table 7.1-1.

Table 7.1-1: Potential Pros and Cons of Covering Methods

PROS	CONS
When properly executed appears to eliminate stems beneath plastic (TNC, 2003).	Labor Intensive (cutting of stems, then covering with plastic) (TNC, 2003).
No concerns with effect of herbicide use such as public perception or unknown biological effects.	Plastic may rip or deteriorate allowing stems to push through (TNC, 2003).
	Requires frequent monitoring to treat growth extending out from the edge of plastic (TNC, 2003).
	Does not improve effectiveness of using herbicide.
	Eliminates all plants covered including non-target natives (unlike selective herbicide application).

Hand Pulling: Hand pulling Common reed can be effective in small stands (*i.e.*, < 100 plants) where soils are loose and sandy (TNC, 2003). This technique attempts to target the rhizomes of the Common reed, in order to prevent growth and spread. Common reed rhizomes are often very extensive below ground, therefore this method is extremely labor intensive and typically requires long-term repeated treatments (See Table 7.1-2). Hand pulling could be used effectively in limited cases where a single stem may be observed during monitoring or other activities are taking place. Large scale use of this method is not recommended, as it is labor intensive and not cost effective.

Table 7.1-2: Potential Pros and Cons of Hand Pulling Methods	
PROS	**CONS**
Pulling to a depth of 3' was shown to result in sparse re-vegetation the following year (TNC, 2003)	Very labor intensive (TNC, 2003).

Cutting/Mowing: Cutting of Common reed stems can be effective when used in combination with herbicide treatment. The most successful mechanical treatments also include an application of herbicide either before or after mechanical cutting have taken place. Cutting Common reed in mid summer to weaken plants and stimulate additional sprouting followed by a late season (September) herbicide application can be effective (George Spak personal communication, 2008). In contrast, herbicide application first followed later by a mechanical removal has also been proven to be effective (MDNR, 2008; TNC, 2003). In this case, cutting or mowing should begin two weeks after the initial herbicide application (MDNR, 2008). Soil disturbance should be kept to a minimum, therefore mechanical methods involving large equipment should occur during time frames when the least amount of soil disturbance will occur. The remaining thatch from cut stems can be removed once cutting is complete to allow for re-vegetation from the native seed bank. It is important to note that if not done correctly, cutting and mowing alone may stimulate the growth of Common reed. However, cutting in combination with herbicide treatment is considered effective (MDNR, 2008; TNC, 2003). In order to avoid rapid reed regeneration, cutting should take place in the late summer or fall unless combined with herbicide treatment. While soil disturbance is generally avoided when treating Common reed, disking in some cases may enhance mechanical control methods. Mowing regimes over several years (during the summer) followed by disking in the late summer and fall may be effective (TNC, 2003). It should also be noted that caution should be used when disking as cut rhizome materials can still spread. Serious soil disturbance is not an appropriate control method and should be avoided as it may worsen the invasion, remove native vegetation, and impact wetland habitat. All machinery used in any mechanical control program should be thoroughly cleaned to avoid transplanting Common reed. When used properly in combination with herbicide, cutting can be a very effective tool in controlling Common reed (MDNR, 2008; TNC, 2003). Currently the U.S. Fish and Wildlife Service (USFWS) operates an amphibious harvester

in New York State that is specifically designed to remove marsh vegetation. This vehicle is a track vehicle with pontoons and a cutter attachment that can actually operate in and cross over shallow open water. While the availability of an amphibious harvester is not known at this time, it may be a potential supplemental method of control. Potential draw-backs and benefits of this method are presented in Table 7.1-3.

Table 7.1-3: Potential Pros and Cons for Cutting Methods

PROS	CONS
Cutting can be effective if used in combination with herbicide (MDNR, 2008).	Cutting several times (or during the wrong time) may result in an increase in stand density (MDNR, 2008; TNC, 2003).
Cutting while shoots are submerged in June has been proven to be effective (TNC, 2003; Smith, 2005)	May negatively impact native wetland vegetation (MDNR, 2008).
Manual cutting tools (such as weed whips or hand tools) can be effective after or prior to herbicide in low density stands (MDNR, 2008).	May require special permitting for mechanical mowing of areas below the high water mark.

Burning: A prescribed fire can be an effective management tool for Common reed control when used in conjunction with herbicide treatment (See Table 7.1-4). In areas where a prescribed burn can be implemented safely, burning offers a cost effective form of control. Burning is recommended for dense stands and only after the use of an approved herbicide. Prescribed fire should be conducted the year following herbicide treatment in late summer or winter (MDNR, 2008). A burn conducted as a second year treatment in later summer is ideal. Burning in the late summer destroys seed heads, removes accumulated thatch, and helps to kill stems that may have survived the initial herbicide treatment. The large amount of accumulated thatch and dead stems causes Common reed stands to burn quickly and at high temperatures. The preparation of a burning plan is important to the safe use of fire as a treatment method (MDNR, 2008). Approval from local fire officials will be required before any burn takes place and all fires must be overseen by properly trained personnel. Burning is a very effective tool for the removal of thatch following herbicide application (MDNR, 2008).

Table 7.1-4: Potential Pros and Cons of Burning	
PROS	**CONS**
Cost effective and ecologically sound method for thatch removal (MDNR, 2008).	Requires additional permitting and oversight from fire control officials/experts.
Proven successful when used in combination with herbicide (MDNR, 2008)	Smoke may become an issue in populated areas (reducing visibility and air quality).
Burning as a post treatment to herbicide can increase species diversity (MDNR, 2008; Ailstock 2001).	If not done correctly burning may stimulate growth of Common reed (MDNR, 2008; TNC, 2003).
Removes thatch and allows light penetration (MDNR, 2008; Ailstock 2001).	Common reed stands burn quickly and at high temperatures making safety a serious concern (MDNR, 2008).

Water level control: Flooding can be used to control Common reed (See Table 7.1-5), but is generally only effective when used with additional control measures (such as cutting) (MDNR, 2008). Smith (2005) noted success in Common reed control using cutting combined with flooding within marshes in Cape Cod. In this particular study breaking off and removing Common reed stems below the water surface resulted in as much as a 99% decrease (59%-99% range in decrease for treated stands) in the total population size of Common reed. The study concluded that repeated underwater breakage and removal of stems significantly reduced Common reed population size the following year.

Table 7.1-5: Potential Pros and Cons for Water Level Management	
PROS	**CONS**
Common reed is intolerant of extended flooding (MDNR, 2008).	May require construction of water retention structures as well as ongoing management requirements.
Flooding in combination with cutting below the water surface has met with success (TNC, 2003; Smith 2005).	Flooding may destroy non target native communities (TNC, 2003).

7.1.2 Chemical

Chemical control of Common reed primarily relies upon one of two broad spectrum herbicides, using Glyphosate and Imazapyr formulations, both of which are available commercially. The aquatic approved formulations of herbicides must be used when treating stands in marsh or wetland habitats. In order to ensure that the applied herbicide is taken up by the plant, a non ionic surfactant should be used along with the herbicide. The surfactant must be state approved. Additionally, mixing of herbicides requires the use of clean, preferably distilled, water to prevent the herbicide from binding to sediments. Glyphosate binds tightly to sediments and will be rendered ineffective if mixed with un-clean water (TNC, 2003). Methods of application should wet the leaves and flowers (when present). Excessive application should be avoided as this will result in damage to non target species. While herbicide may be a cost effective form of control, special consideration should be given to the method of application to limit the potential for drift. For any herbicide application the instructions provided by the manufacturer on the product label must be followed at all times. An individual trained and certified as a Category 5a pesticide applicator should be acquired to conduct any work utilizing herbicides in wetlands. **It should be noted that current NY Regulations require that herbicide dilutions follow the manufacturer's specifications provided on the product label. At no time should these mixing instructions be modified, unless the manufacturer develops supplemental labeling materials approved by the State.**

A number of application methods have been used and tested to limit the exposure of non target species and ensure adequate application to target Common reed stems. These control methods include:

Cut Stem Method: Stems are cut to waist height and a directed spray of herbicide is added to the hollow stems by spray bottle. Herbicide is applied in a diluted concentration (mixed) into the stem cavity. This particular method is suggested for scattered or isolated stems of Common reed or in areas where the potential for impacts to native herbaceous plants exists. This method has been used to successfully treat small patches of Common reed while limiting exposure to non-target species. Based on the review of the literature this method is highly recommended for small and low density stands of Common reed. Typically, in low density stands less volume of the herbicide is needed. Table 7.1-6 details the benefit and draw backs to this method.

Table 7.1-6: Potential Pros and Cons of Stem Injection/Clip and Drip Methods	
Pros	**Cons**
Can work well on isolated stems or small patches and low density patches (e.g. 0-30% areal cover) (TNC, 2003).	May require special permitting or certification for application (MDNR, 2008).
Reduced impact to non-target species and limits potential for drift (TNC, 2006; Kiviat, 2006).	Labor intensive.
May be used in combination with cutting and burning (Kiviat, 2006).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
	May need to remove cut stems. Some information suggests leaving cut stems may negatively impact native vegetation
	The stem injection/cut stem method using undiluted herbicide is not currently approved for use by NYSDEC
	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).

Hand Swiping: Stems are covered with diluted herbicide by wiping them with a cotton wicking glove worn over a chemical resistant glove. Herbicide formulations must follow mixing instructions provided on the product label. As with the cut stem method this method is also labor intensive and is best used on scattered or isolated stems of Common reed (Table 7.1-7). This method is also effective when trying to avoid impacts to non target species. While this method can be an effective form of control it is not recommended for large scale patches and/or dense patches.

Table 7.1-7: Potential Pros and Cons of Hand Swiping Method	
PROS	**CONS**
Can work well on isolated stems or small patches and low density (e.g., 0-30% areal cover) patches.	May require special permitting and certification for application (MDNR, 2008).
Reduced impact to non-target species and limits potential for drift.	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).

Backpack Spray Application: Herbicide is applied by the use of a pressurized backpack spray unit. The most effective technique applies herbicide under low pressure at a

close distance to the leaves. This particular application method can be used effectively in moderately dense to dense stands of Common reed (Table 7.1-8). Concentrations of herbicide should follow the formulations provided on the chemical label for low volume spray application. In order to avoid impacts to non target species application should take place on low wind days using flat fan nozzles. Low volume backpack sprayers have an increased potential for drift when compared to the cut-stem or wiping techniques. However, in larger more dense patches of Common reed this method can efficiently treat and limit impacts to the environment. This method is recommended for large dense stands where more labor intensive methods (cut-stem, wiping, etc) would not be cost effective.

Table 7.1-8: Potential Pros and Cons for Backpack Herbicide Application

PROS	CONS
Can reduce non-target impact and drift when compared to broadcast spray or aerial application (TNC, 2003).	May require special permitting and certification for application (MDNR, 2008).
Requires minimal equipment (Herbicide and PPE) (DowAgro, 2008).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
Effective in moderate (e.g. 30-75% areal cover) density stands (DowAgro, 2008).	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).
Solution volumes between 5-30 gallons per acre (DowAgro, 2008).	Suggested application for heights of less than 6-8 ft (DowAgro, 2008).

Wick/Dauber Application: Diluted Herbicide (mixed according to product labeling instructions) is applied by saturating absorbent materials attached to a low pressure spray apparatus attached to an ATV or tractor. This method reduces non-target impacts due to over-spray by saturating materials (rags, towels, or other absorbent materials) attached to a boom. The material is saturated by diluted herbicide and is transferred from the boom to the plant as the ATV or tractor drives through the stand. This method can be used in moderate to dense stands (primarily greater than 1 acre) of Common reed. Areas treated by this method must be covered twice (once in each direction) (Table7.1-9). Stems damaged by equipment will not be affected by the herbicide application. This method targets primarily Common reed as the saturated Wick/Dauber avoids non target species of shorter stature than the Common reed. The majority

of Common reed patches at Tifft are not readily accessible. This, combined with the increased potential for non-target impacts, and the potential for damage from ATV or tractor use, limits the usefulness of this method.

Table 7.1-9: Potential Pros and Cons to Wick/Dauber Application

PROS	CONS
Effective in medium density stands (e.g., 30-75% areal cover) (MDNR, 2008).	Requires special permitting and certification for application (MDNR, 2008).
Reduces drift and impacts to short stature vegetation (MDNR, 2008).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
Time efficient, providing access is available.	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).
	Requires patches be accessible by equipment and located at drier sites.

Boom Sprayer Application: Diluted Herbicide (Mixed following product label instructions and concentrations) application takes place using a boom that is attached to an ATV or tractor. This method involves uninterrupted spraying, and can be used in dense stands (> 75% aerial cover) as well as large stands (greater than an acre). Application is most effective when using low pressure application on low wind days to prevent drift. Stems damaged by equipment (*e.g.*, broken stems) will not be affected by the herbicide application as herbicide will not be effectively trans-located to rhizomes from the stems. In some cases very large stands of Common reed, that are easily accessible by ATV, may be treated by this method. This method is not recommended for large scale use, but may be effective given certain circumstances (Table 7.1-10).

Table 7.1-10 Potential Pros and Cons of Boom Spray Herbicide Application Methods	
Pros	**Cons**
Treats high density stands (e.g., 75-100% areal cover) effectively (DowAgro, 2008).	Requires special permitting and certification for application (MDNR, 2008).
Can be used on heights greater than 6-8 feet (DowAgro, 2008).	Potential for loss of herbicide from the stem or roots into the soil (Kiviat, 2006).
Time efficient when equipment access is available.	Glyphosate is typically applied for 2-3 years for thorough control (Kiviat, 2006).
	Greater potential for non-target impacts and drift.
	Requires patches be accessible by equipment and located at drier sites.

Aerial Application: Application of herbicide occurs from the use of helicopter boom sprayers using appropriate droplet size, boom length, and nozzle type. Typically this type of application is used only on patches exceeding 5 acres in size (Table 7.1-11). This type of application may result in major impacts to native communities due to drift that occurs during application and is generally only used to treat large (> 5 acres) stands because of drift; aerial application is also intended for remote areas, not frequented by the general public.

Table 7.1-11: Potential Pros and Cons for Aerial Application Methods	
PROS	**CONS**
Treats large (Greater than 5 acres) dense stands (MDNR, 2008).	Requires special permitting and certification for application (MDNR, 2008).
Can be used on heights greater than 6-8 feet (DowAgro, 2008).	High potential for non target impacts and drift (MDNR, 2008).
Time efficient.	Suggested only for stands 5 acres or greater in size (MDNR, 2008).

8.0 SPECIAL CONCERNS

This section discusses important considerations for selecting recommended control methods for Tifft. For effective control of Common reed, ease of access is particularly important for using mowing equipment or larger ATV mounted spraying equipment so as not to damage marsh habitat. In addition studies have indicated some risk associated with the use of herbicides to amphibian communities (Kiviat, 2006). In order to avoid potential impacts herbicide application instructions should be followed. Application during periods of low wind or utilizing appropriate application techniques can help reduce the amount of drift. Special care should be given when spraying in aquatic environments to avoid direct application into water. Generally use of this equipment would only be advisable in large patches. In Tifft the largest patches of Common reed are accessible. The largest patches border non-wetland cover types along the transmission right of way. Other patches are located in the Marsh interior and are less accessible. Much of the study area is not effectively accessed by large equipment or ATVs because deep channels and sensitive wetlands either cannot or should not be crossed. For the majority of the 57 total patches, access by larger equipment is limited. The U.S. Fish and Wildlife Service (USFWS) operates an amphibious harvester in New York specifically designed to remove marsh vegetation. Equipment such as this has limited potential to access some of the stands within Tifft. While specialized aquatic equipment has some potential to be used in mechanically treating larger stands, it is not recommended for use within Tifft, with the possible exception of the largest stands in the vicinity of the power line ROW. Amphibious harvesters may damage existing marsh vegetation and further spread invasive Common reed within Tifft. The benefit of quickly mowing large patches in easily accessible areas may be lost due to the damage caused to the marsh and the potential to disperse Common reed rhizomes and seeds into additional areas of the marsh.

Flood management is a feasible method of control in some areas, as discussed above, but at Tifft it is not a viable option. Currently water levels within the study area are maintained by a control structure along the western boundary of the marsh. A pump controls water levels within the marsh during the year. In order to maintain water elevations at levels significant enough to impact Common reed expansion and growth, a berm would need to be constructed at the southern extent of the marsh.

Currently the elevation of the area to the south of the marsh is the limiting elevation for the water surface. Construction activities are not included in the scope of the habitat improvement project, therefore, water level control is not proposed for the control of Common reed within Tifft. However, water levels at Tifft will be managed by Buffalo Museum of Science staff using existing water control structures to prevent further spread and establishment of Common reed. For example, maintaining high water levels in the spring or pumping water into the marsh during periods of low water levels.

Controlled burning has been proven as a beneficial method for efficient thatch removal after initial herbicide treatment (MDNR, 2008). Burning can increase the amount of native vegetation re-growth after treatment has taken place. Due to the location of Tifft and its close proximity to a major highway and areas of high population density, burning may not be feasible. Additionally, approval and permits from State and Local officials would be necessary as well as a professionally prepared burn plan and cooperation with local fire departments.

Covering of Common reed requires significant effort to control even small infestations. Based on the need to cover in combination with multiple visits to ensure plastic does not deteriorate, this method is not recommended for use within Tifft. The method is not recommended primarily because of the high level of labor required and high cost for control of very small areas relative to effectiveness.

The majority of Common reed stands located within the study area are less than 0.1 acres in size (39 of 57 stands) and only three of all of the stands are 1.4 acres or greater. Aerial herbicide application has been used effectively in large (> 5 acres) stands (MDNR, 2008; TNC 2008). While aerial application may be effective in stands greater than 5 acres, based on the data collected in the Marsh, it is not recommended within Tifft.

The use of ATV sprayers may be feasible on some patches, provided that access is available. A majority of patches can only be accessed by boat or by crossing portions of the marsh interior. In these areas treatment through the use of ATV or other machinery (for cutting or herbicide treatment) is not recommended within Tifft Marsh. In some of the larger patches, primarily those located along the power line right of way, the use of machinery may increase efficiency as the patches are close (or adjacent) to areas of access. The largest patches of

Common reed (Site Numbers 48, 56, and 57) within Tifft are adjacent to non-wetland areas and have easy access.

9.0 RECOMMENDED CONTROL METHODS

9.1 Overall Approach

The *Common Reed Dominated* and *Mixed Species Common Reed Present* cover types present within Tifft occupy 11.1 acres (or 15.0%) of the total acreage (73.8 acres) of cover types identified within the study area. Within Tifft Common reed stands range both in size and density; therefore different management strategies for stands of various sizes must be considered. Long-term management and monitoring are required to ensure that management goals are achieved. The planned actions selected are expected to reduce the presence of Common reed in specific locations and facilitate the re-vegetation of native species in those areas.

In order to best meet the goals of this Action Plan set forth in Section 2.0, monitoring and management of strategies particularly suited to Tifft are outlined in this section. For Tifft, given the limitations and considerations identified in Section 7.0, herbicide application in combination with mechanical methods such as cutting, are the most appropriate approach. This approach targets Common reed stands for treatment using herbicide and mechanical means in order to protect native plant diversity by removing and controlling invasive patches of Common reed. Common reed stands will be managed based on the specific priority rank given to each group, with those groups of high priority being treated first. A phased approach will be used to control Common reed within Tifft (Figure 9.1-1).

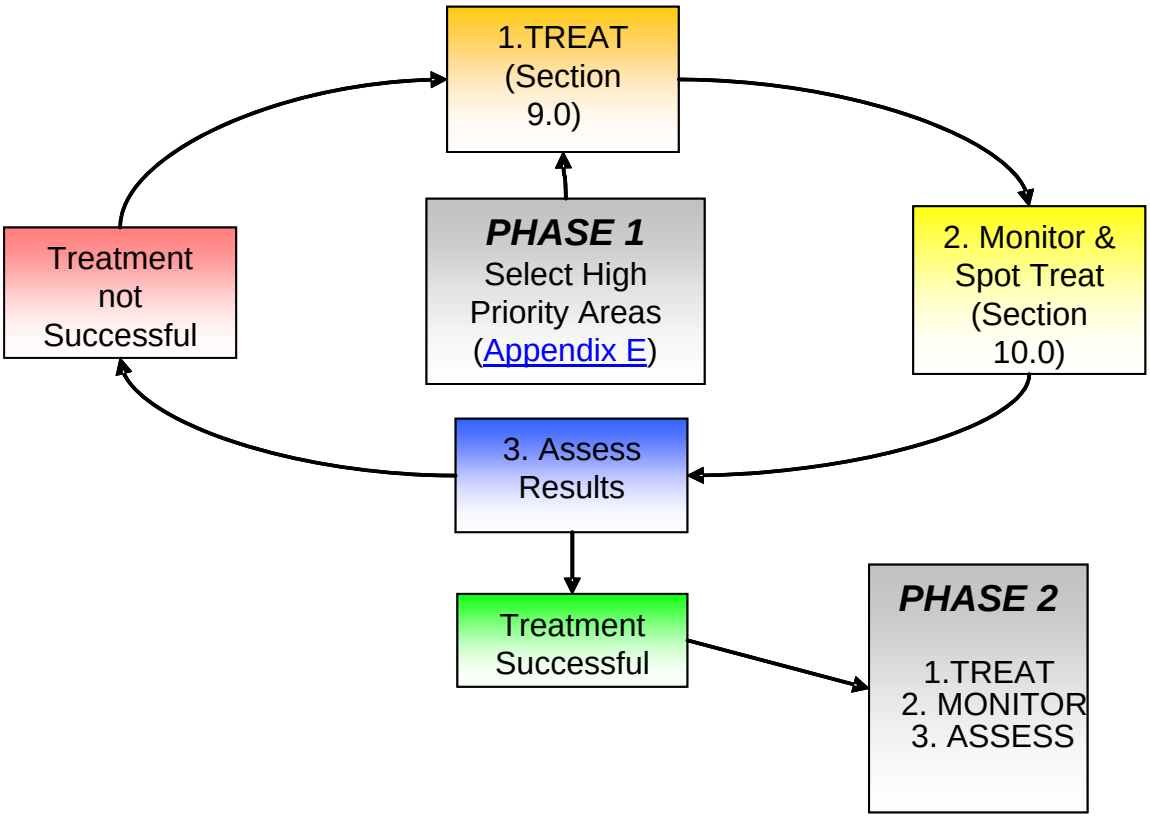
Phase 1 will consist of the selection and treatment of high priority groups. Phase 1 will include one year of initial treatment starting with high priority groups (2, 4, 5, 6, 8, 9, and 13). Each stand will receive a treatment outlined in Sub-sections 9.2.1 and 9.2.2. Following treatment, monitoring of vegetation and continued spot treatment will occur. Monitoring within these polygons will determine the effectiveness of the initial treatment (Section 10.0). Following vegetation data collection, these areas will receive the second year spot treatment targeting new growth or individuals missed during the initial treatment. A second year “spot” treatment increases the level of control within stands of Common reed and will be used for all treatments. In subsequent years, the need for

spot treatment will be dictated by monitoring results (TNC, 2003; MDNR, 2008; Kiviat, 2006). Phase 2 will begin within 1-2 years of the initial Phase 1 treatment, however Phase I sites will continue to be monitored and treated (as necessary) even when Phase 2 has been initiated. If even a few rhizomes are left the entire treated area can potentially return to Common reed (TNC, 2003); therefore it must be ensured that all treated areas are continually monitored and spot treated as necessary.

Continual monitoring following the year of initial treatment will allow for adjustments of methodologies (if needed). Additional phases will consist of the initial treatment of the highest priority groups remaining. Subsequent groups will be selected based on their assigned rank, focusing on those groups with the highest priority ranking first (Appendix E). As above, after the initial treatment takes place, monitoring and the follow up spot treatment will occur. Based on observations and an assessment of the results a determination of whether the stands have been treated successfully will be made. The success criteria of any given stand will be based on 100% elimination of the Common reed within the stand.

It is more effective to successfully treat fewer polygons than unsuccessfully treat many since if any live plants are left, Common reed (and potentially other invasives as well) can potentially re-invade the treated area. The adaptive management approach is intended to ensure that the most successful control methods are used and that treated areas do not return to Common reed. Complete control is often not achievable on a landscape scale, but may be achievable for small, isolated stands (Section 2.0). Treatment methods commonly suppress Common reed growth for 2-3 years after the second year of spot treatment (Ailstock, 2001; MDNR, 2008; TNC, 2003).

Figure 9.1-1: Common Reed Management Flow Chart



Control Steps:

- Select treatment areas based on priority ranking (Appendix E)
- Treat selected areas utilizing recommended methods (or modifications of these based on results from Phase 1)
- Monitor treated stands and complete spot treatment
- Determine additional stands to be targeted the following year (based on success)

Repeat above steps and continue annual monitoring of all treated areas

9.2 Recommend Treatment Options

Common reed control is most effective when multiple stresses are introduced through the use of multiple treatments (MDNR, 2008). Based on the research of current control methods for Common reed and the conditions at Tifft Marsh, a combination of herbicide treatment and mechanical removal has been selected as the primary control mechanisms. It should be noted that any method requiring the use of herbicide will require the use of a qualified (Category 5A certified) herbicide applicator. Permits for mechanical or chemical control within a wetland will also be required. Specifically a Joint Application (NYSDEC and U.S Army Corps of Engineers) for freshwater wetlands will need to be obtained in accordance with Article 15, Title 3 of the Environmental Conservation Law and Parts 327 and 328 of the New York Code of Rules and Regulations. Additionally the use of herbicide within the vicinity of development may be limited by State or County regulations. At a minimum Erie County, NY requires a 48 hour notification of neighbors for certain commercial applications of herbicide (NNL, Chapter 285 of the Laws of 2000, Sections 33-1004 and 33-1005). Currently the Buffalo Museum of Science through a lease with the City of Buffalo manages the Nature Preserve to the west of the marsh. To the south of the Marsh are several parcels owned by a variety of owners. The largest parcel bordering the southern extent is owned by the City of Buffalo and used for athletic fields. There is also a NYS Department of Transportation (NYSDOT) mitigation wetland located directly south of the old landfill. This parcel does not border the Marsh portion described in this Action Plan. Located between the City and State owned properties to the south are three parcels, two of which are owned by the Niagara Frontier Transit Authority and the third parcel by an unknown owner (Spiering, 2008). To the east the land is owned by the Lehigh Valley Railroad, now bankrupt. This parcel follows the entire eastern perimeter of the Marsh. Between the larger Lehigh Valley parcel and the Marsh are two parcels owned by the Niagara Mohawk Corporation that run beneath two power line ROWs. The existing lease between the City of Buffalo and the Society of Natural Sciences allows a wetland easement on the Niagara Mohawk property (Spiering, 2008). Because this application would take place with the potential for public exposure (i.e. along trails and overlooks) an ENB (Environmental Notification Bulletin) may be required. This bulletin would be posted in a local news publication with a 30 day public comment period. Proper signage, following DEC regulations, would

also be required. More information pertaining to herbicide application and associated regulations within the State of New York is available on the NYDEC website (http://www.dec.ny.gov/25.html).

For all herbicide applications the formulation of herbicide should follow the manufacture's instructions (see herbicide label) and be an aquatic approved formulation with a state approved non-ionic surfactant (MDNR, 2008). **It should be noted that current NY Regulations require that herbicide concentrations follow the manufacturer's specifications provided on the product label. At no time should these mixing instructions be modified, unless the manufacturer develops supplemental labeling materials approved by the State.** Application of the herbicide will take place in September (when plants are in flower), which is when plants are translocating nutrients from above ground and the herbicide is most effective. Mechanical cutting will occur preceding the initial treatment which may enhance the effectiveness of control efforts. Mechanical control completed prior to herbicide application should take place in late July using mowers, brush-saws, or hand tools. When cutting occurs, plants should be allowed to re-grow for approximately two months before herbicide application takes place (late summer or early fall). Monitoring (See Section 10) and spot treatment will continue until Common reed is no longer observed within the stand. Following the second year monitoring, a September spot treatment of new growth will be conducted by backpack spray application of an approved aquatic Glyphosate based herbicide. A low pressure backpack sprayer with fan nozzles will be used to apply herbicide to the new shoots of Common reed. All subsequent spot treatments to control new growth will be by backpack spray application of a Glyphosate based, aquatic-approved herbicide. In general, thatch removal will not take place unless additional resources become available. If additional resources are available, such as volunteer workers, thatch removal may be an attractive option. In the event that it is not possible to remove thatch it will be left within the existing stand. Thatch removal can be beneficial to the re-growth of native vegetation, although in some cases increased biodiversity has been attributed to remnant thatch (Ailstock, 2001).

9.2.1 Dense Stands

Dense stands (≥75% areal cover) are divided into two separate approaches (Approach 1 and 2) as detailed below, because large (greater than 0.5 acres) stands require a different approach to control

than those dense stands that are small or medium (less than 0.5 acres). Specific stands and treatment approach are shown below in Table 9.2.1.

Table 9.2.1-1. Identified Stands for Dense Stand Treatment (Approach 1 and 2)

Cover Type	Survey ID	Site Number	Invasive Cover %	Acres	Approach
COMMON REED DOMINATED MARSH	t phrag 18	43	85	0.035	2
COMMON REED DOMINATED MARSH	t phrag 45	50	90	0.075	2
COMMON REED DOMINATED MARSH	t phrag 8	57	85	0.11	2
COMMON REED DOMINATED MARSH	t phrag 50	53	75	0.046	2
COMMON REED DOMINATED MARSH	t phrag 35	47	98	0.329	2
COMMON REED DOMINATED MARSH	t phrag 36	48	75	0.072	2
COMMON REED DOMINATED MARSH	t mix 3	17	75	0.081	2
COMMON REED DOMINATED MARSH	t phrag 4	49	95	0.303	2
COMMON REED DOMINATED MARSH	t phrag 6	54	80	0.131	2
COMMON REED DOMINATED MARSH	t phrag 1	42	90	0.157	2
COMMON REED DOMINATED MARSH	t mix 38	24	75	0.912	1
COMMON REED DOMINATED MARSH	t phrag 25	46	95	1.942	1
COMMON REED DOMINATED MARSH	t phrag 7-2	56	75	0.221	2
COMMON REED DOMINATED MARSH	t phrag 6-2	55	75	0.385	2
COMMON REED DOMINATED MARSH	t phrag 45	51	90	0.946	1
COMMON REED DOMINATED MARSH	t phrag 45	52	90	0.003	2
COMMON REED DOMINATED MARSH	t phrag 22	45	98	1.417	1
COMMON REED DOMINATED MARSH	t phrag 19	44	98	1.623	1

Approach 1, Large (0.5 acres or greater) Dense Stands:

Control measures for large dense stands (≥75% aerial cover) of Common reed will include a combination of herbicide treatment and mechanical treatment to weaken stands prior to herbicide application. Table 9.2.1-1 outlines those patches targeted for this approach. This method calls for an initial treatment using mechanical cutting in late July, followed by an herbicide application in late summer or fall when Common reed is translocating nutrients and energy into its rhizomes. Because of the larger scale of these dense stands, the herbicide may be applied using a boom sprayer attached to an ATV (See Section 7.1.2). It should be noted that ATV application is not recommended for patches within the marsh as this will result in extensive damage to the marsh community. Use of ATVs should be considered for patches outside the marsh, such as those under the ROW on the eastern edge

of the Preserve. In areas that may have access constraints, alternate application methods may be required (*i.e.* back-pack sprayers) as evaluated on a case by case basis. Cutting in the early summer is beneficial as it further stresses the energy reserves of the plants therefore mechanical treatment should occur in late July, prior to herbicide application. Following the cutting, once new growth has become established and flowers (late summer or early fall), herbicide should be applied following the methods above. It should be noted that large dense stands will only be treated once the higher priority groups have been successfully controlled. Large patches may also require the development of a planting plan to ensure that additional invasive species do not re-invade after the disturbance caused by treatment of Common reed. Large dense Common reed stands are not the highest priority stands. During the early stages of this control plan, these large dense stands will primarily be lowest in priority (Appendix E).

It should be noted that treatment of large dense stands of Common reed will result in extensive exposure of bare substrates that may require additional work in order to ensure the establishment of native vegetation. Monitoring will be an important factor in determining whether additional plantings are necessary to prevent re-invasion of treated stands by Common reed and other invasive species. In cases where the removal of Common reed results in the loss of the majority of vegetative cover (large scale mowing or soil disturbance) native plantings may be used to ensure the establishment of beneficial native species. Seed mixes or plugs should be obtained from a plant nursery specializing in native marsh vegetation. Mixes should include native marsh species that provide benefit to the marsh as well as wildlife. Potential species to be considered for planting include, but are not limited too, those in Table 9.2.1-2.

Table 9.2.1-2: Potential Plant Species for use in Planting Plans

COMMON NAME	SCIENTIFIC NAME	HABITAT
Lake bank sedge	*Carex lacustris*	Marsh
Wool grass	*Scirpus cyperinus*	Marsh
Sweet-flag	*Acorus calamus*	Marsh
Canada blue joint	*Calamagrostis canadensis*	Marsh
Three-way sedge	*Dulichium arundinaceum*	Marsh
Three square	*Schoenoplectus americanus*	Marsh
Blue flag	*Iris versicolor*	Marsh
Blue vervain	*Verbena hastata*	Marsh
Soft rush	*Juncus effusus*	Marsh
Softstem bulrush	*Schoenoplectus tabernaemontani*	Marsh
Arrowhead	*Sagittaria latifolia*	Deep Marsh
Pickerel weed	*Pontederia cordata*	Deep Marsh
Speckeld alder	*Alnus incana*	Shrub

Table 9.2.1-2: Potential Plant Species for use in Planting Plans (Cont'd)

COMMON NAME	SCIENTIFIC NAME	HABITAT
Button bush	*Cephalanthus occidentalis*	Shrub
Red osier dogwood	*Cornus stolonifera*	Shrub
Wild raisin	*Viburnum cassinoides*	Shrub
Arrow wood	*Viburnum recognitum*	Shrub

Approach 2, Small to Medium (0.0-0.5 acres or less) Dense Stands:

Some small dense (≥ 75% areal cover) stands may be of high priority especially if near sensitive native habitats and easily accessible. The smaller size of these patches makes the use of heavy equipment impractical due to inefficiencies accessing sites and associated damage to the surrounding habitat. Therefore, mechanical cutting followed by a foliar application using backpack sprayers is most appropriate. The density of these stands also limits the efficiency of the cut stem method or wiping (even though the stands are small in size there may be hundreds or thousands of stems). Table 9.2.1-1 outlines those patches targeted for this approach. In situations where stand size is less than 0.5 acres and areal cover is identified as being greater than or equal to 75%, a combination of mechanical cutting and foliar application of Glyphosate based, aquatic-approved herbicide will be the primary method of control. Cutting should occur in early summer (late July) using brush-saws or hand tools. Herbicide should be applied in late summer or fall once Common reed has gone to flower. The effectiveness of this foliar application will be determined by monitoring (Section 10.0).

9.2.2 Medium Density Stand Approach

Stands of medium density are those identified as having an estimated areal cover of greater than 30% and less than 75%. The control method for medium density stands is the same regardless of the patch size. Table 9.2.2-1 identifies stands targeted for the medium density approach. These stands will be treated initially by mechanical means in late July using brush-saws or hand tools, followed by a foliar application of herbicide using hand equipment, such as backpack sprayers, as detailed in Section 7.1.2. Herbicide application should follow the cutting, once new growth has become established and Common reed has gone to flower (late summer or early fall). The density of these

stands limits the efficiency of the cut stem method or wiping (even though the stands may be small in size). The effectiveness of this foliar application will be determined by monitoring (Section 10.0).

Table 9.2.2-1. Identified Stands for Medium Density Stand Treatment

Cover Type	Survey ID	Site Number	Invasive Cover %	Acres
MIXED SPECIES COMMON REED PRESENT	t mix 17	8	48	0.007
MIXED SPECIES COMMON REED PRESENT	t mix 56	35	70	0.057
MIXED SPECIES COMMON REED PRESENT	t mix 9	41	33	0.162
MIXED SPECIES COMMON REED PRESENT	t mix 48	27	35	0.01
MIXED SPECIES COMMON REED PRESENT	t mix 34	22	60	0.167
MIXED SPECIES COMMON REED PRESENT	t mix 1, 2, and 4	1	45	0.1540
MIXED SPECIES COMMON REED PRESENT	t mix 59	38	45	0.187
MIXED SPECIES COMMON REED PRESENT	t mix 5	29	40	0.05
MIXED SPECIES COMMON REED PRESENT	t mix 7	40	50	0.04
MIXED SPECIES COMMON REED PRESENT	t mix 51	30	50	0.554
MIXED SPECIES COMMON REED PRESENT	t mix 58	37	45	0.516

9.2.3 Low Density Stand Approach

Stands of low density are those identified as having an estimated areal cover of less than or equal to 30% Common reed. The control method for low density stands is the same regardless of the patch size. Table 9.2.3-1 identifies stands targeted for the low density approach. Low density stands will be treated using cut stem method of herbicide application, using the approved mixture provided on the product label. Prior to the fall treatment stands will be cut in late July without herbicide application. This will introduce multiple stresses to the plant before the cut stem (herbicide treatment) occurs in late summer or fall. This method is an effective tool, both ecologically and economically. The direct application of herbicide to the cut stem reduces the chances of non-target impacts greatly (TNC, 2003; Kiviat 2006).

Treatment of the identified stands will continue in September with the stems of Common reed cut with clippers, brush saws or other hand tools (*i.e.*, no tractors or riding mowers). After cutting the stem, a diluted herbicide will be applied to the cut stem directly using small plastic spray bottles. As an alternative, the swiping method (Section 7.1.2) can be used if conditions are such that it is more efficient.

Table 9.2.3-1. Stands Identified for Low Density Stand Treatment

Cover Type	Survey ID	Site Number	Invasive Cover %	Acres
MIXED SPECIES COMMON REED PRESENT	t mix 23	12	10	0.001
MIXED SPECIES COMMON REED PRESENT	t mix 24	13	15	0.001
MIXED SPECIES COMMON REED PRESENT	t mix 29	16	15	0.011
MIXED SPECIES COMMON REED PRESENT	t mix 14	5	2	0.006
MIXED SPECIES COMMON REED PRESENT	t mix 15	6	10	0.007
MIXED SPECIES COMMON REED PRESENT	t mix 16	7	15	0.006
MIXED SPECIES COMMON REED PRESENT	t mix 60	39	2	0.007
MIXED SPECIES COMMON REED PRESENT	t mix 13	4	2	0.007
MIXED SPECIES COMMON REED PRESENT	t mix 21	11	5	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 20	10	5	0.006
MIXED SPECIES COMMON REED PRESENT	t mix 46	25	20	0.017
MIXED SPECIES COMMON REED PRESENT	t mix 47	26	25	0.026
MIXED SPECIES COMMON REED PRESENT	t mix 10	2	5	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 11	3	5	0.006
MIXED SPECIES COMMON REED PRESENT	t mix 52	31	5	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 53	32	5	0.003
MIXED SPECIES COMMON REED PRESENT	t mix 54	33	5	0.007
MIXED SPECIES COMMON REED PRESENT	t mix 55	34	10	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 57	36	4	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 49	28	25	0.05
MIXED SPECIES COMMON REED PRESENT	t mix 30	18	15	0.003
MIXED SPECIES COMMON REED PRESENT	t mix 31	19	15	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 32	20	20	0.005
MIXED SPECIES COMMON REED PRESENT	t mix 33	21	20	0.008
MIXED SPECIES COMMON REED PRESENT	t mix 37	23	15	0.026
MIXED SPECIES COMMON REED PRESENT	t mix 2	9	30	0.026
MIXED SPECIES COMMON REED PRESENT	t mix 28	15	30	0.125
MIXED SPECIES COMMON REED PRESENT	t mix 27	14	30	0.043

9.2.4 Schedule

Table 9.2.4-1 outlines the general schedule for Common reed treatment. As outlined in Section 10.0, monitoring is continual and ongoing to ensure Common reed does not return to treated stands.

Table 9.2.4-1: Treatment Schedule Based on Stand Type *

		Dense Stand Approach 1	Dense Stand Approach 2	Medium Density Stand Approach	Low Density Stand Approach
Year 1	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun				
	Jul	Mechanical Cutting			
	Aug				
	Sep	Foliar Application of Herbicide Using ATV Potential	Foliar Application of Herbicide Using Backpack Sprayer		Cut Stem Herbicide Application
	Oct				
	Nov				
	Dec				
Year 2	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun	Annual Monitoring			
	Jul				
	Aug				
	Sep	Herbicide Spot Treatment			
	Oct				
	Nov				
	Dec				
Year 3+	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun	Annual Monitoring of Treated Areas with Plot/Invasive Monitoring Occurring every 5 Years			
	Jul				
	Aug	Treatment if dictated by monitoring results			
	Sep				
	Oct				
	Nov				
	Dec				

* Table adapted from MDNR, 2008

10.0 MONITORING

In order to effectively control Common reed within the Marsh, monitoring will be required to determine success as well as identify potential new infestations. Adaptive management strategies rely heavily on information gathered after treatments have occurred. This data allows control methods to be refined and allows adjustments to be made in response to challenges that may occur. Monitoring will occur during the summer (June or July) before any mechanical treatment or spot treatment activities have taken place. During the summer of 2008 fixed monitoring plots were established within the Marsh. A description of these plots is included in Section 4.3 and the baseline data sheets have been included as Appendix D. Figure 4.3-1 shows the location of the established monitoring plots.

10.1 Rare, Threatened, and Endangered Species

The application of herbicide within any natural environment poses some risk to native flora and fauna. It is important to ensure that all measures are taken to avoid impacts to non-target organisms. In order to ensure that no RTE species (particularly plants and birds) are impacted by this invasive species action plan, a survey will be completed prior to any activities within stands slated for treatment. Monitoring will occur on an annual basis within stands targeted for treatment. Monitoring will be conducted only within stands designated for treatment that year. Monitoring will focus on plants and animals (with consideration for RTE species as applicable) to ensure that no valuable species are negatively impacted.

10.2 Annual Monitoring

Annual monitoring will focus on all treated sites and continue until the area has completely re-vegetated and no Common reed is present for as long as it takes up to the term of the license. This monitoring will be qualitative and designed to determine whether new growth of invasives has occurred and whether follow-up spot treatment is required. This monitoring will involve stem counts if stems are few (e.g., < 100 stems) and a qualitative estimate of percent areal cover if stems are numerous (e.g., > 100 stems). This monitoring will also evaluate soil disturbance and re-establishment of native vegetation and any recommendations for native plantings would be made as necessary.

10.3 Five Year Monitoring

Five years after the first treatment, the first five year monitoring will take place and then continue every five years until the successful completion of the project. This monitoring will be more intense than the annual monitoring. Five year monitoring will include data collection at each of the sample plots (8) established in 2008. Plot monitoring will include species identification, stem counts of invasive species, estimate of areal cover percent, and photographs of each sample plot. Additionally the entire Marsh area will be re-surveyed on foot during the winter to allow for easier access to the Marsh interior. The purpose of the five year monitoring will be to identify any new establishment of Common reed within the Marsh and evaluate the fixed monitoring plots. At this time corner stakes at all fixed monitoring plots will be located and orange paint marking these will be refreshed.

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Appendix A: Winter Survey Report

Winter Survey Report Available from NYPA Upon Request

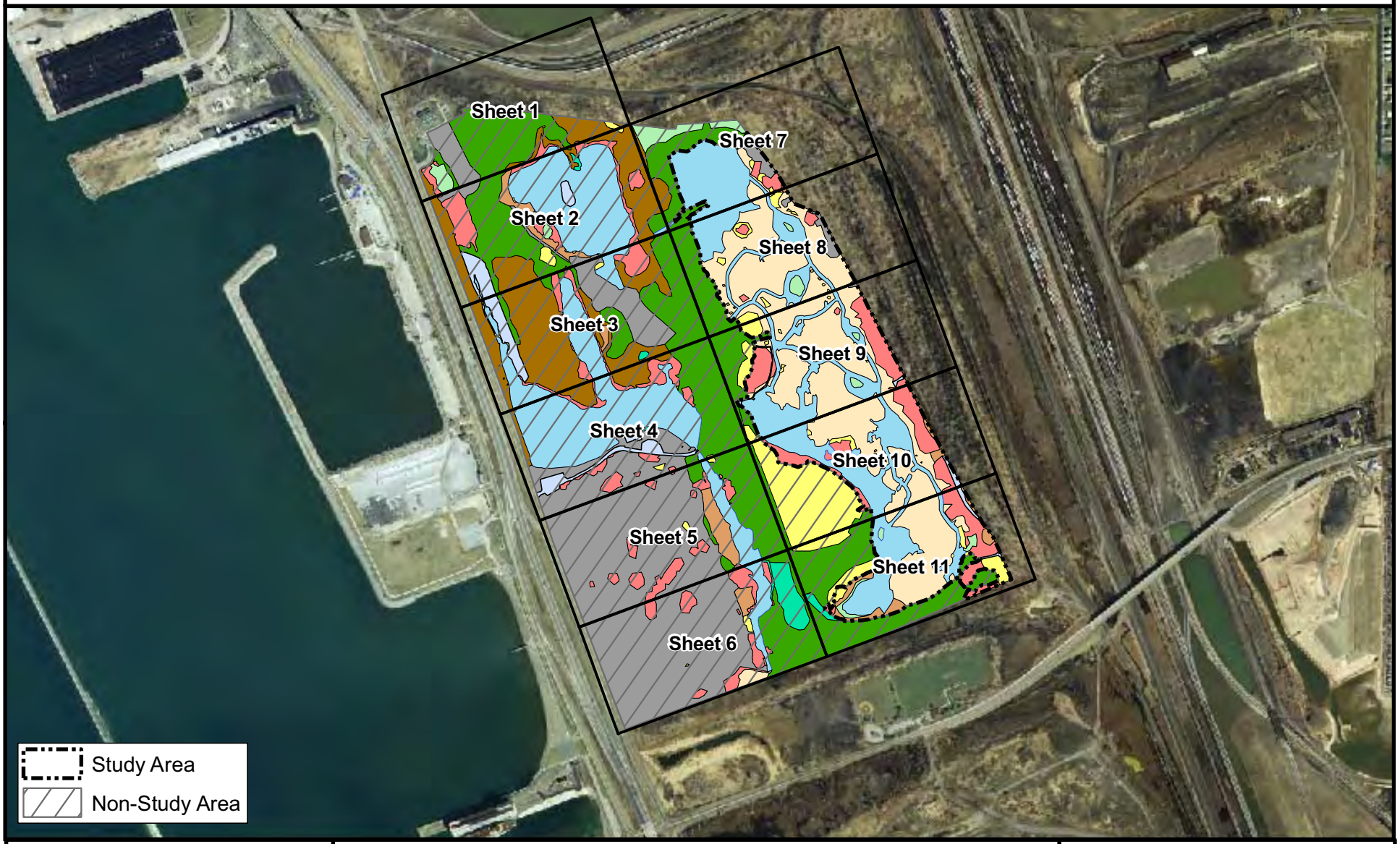
Environmental Department

123 Main Street

White Plains, NY 10601

Appendix B: Tifft Cover Type Mapping

Tifft Cover Type Mapping



N

1 inch = 1,000 feet

0 500 1,000 Feet

Appendix B.
Tifft Cover Type
Index Map

New York Power Authority

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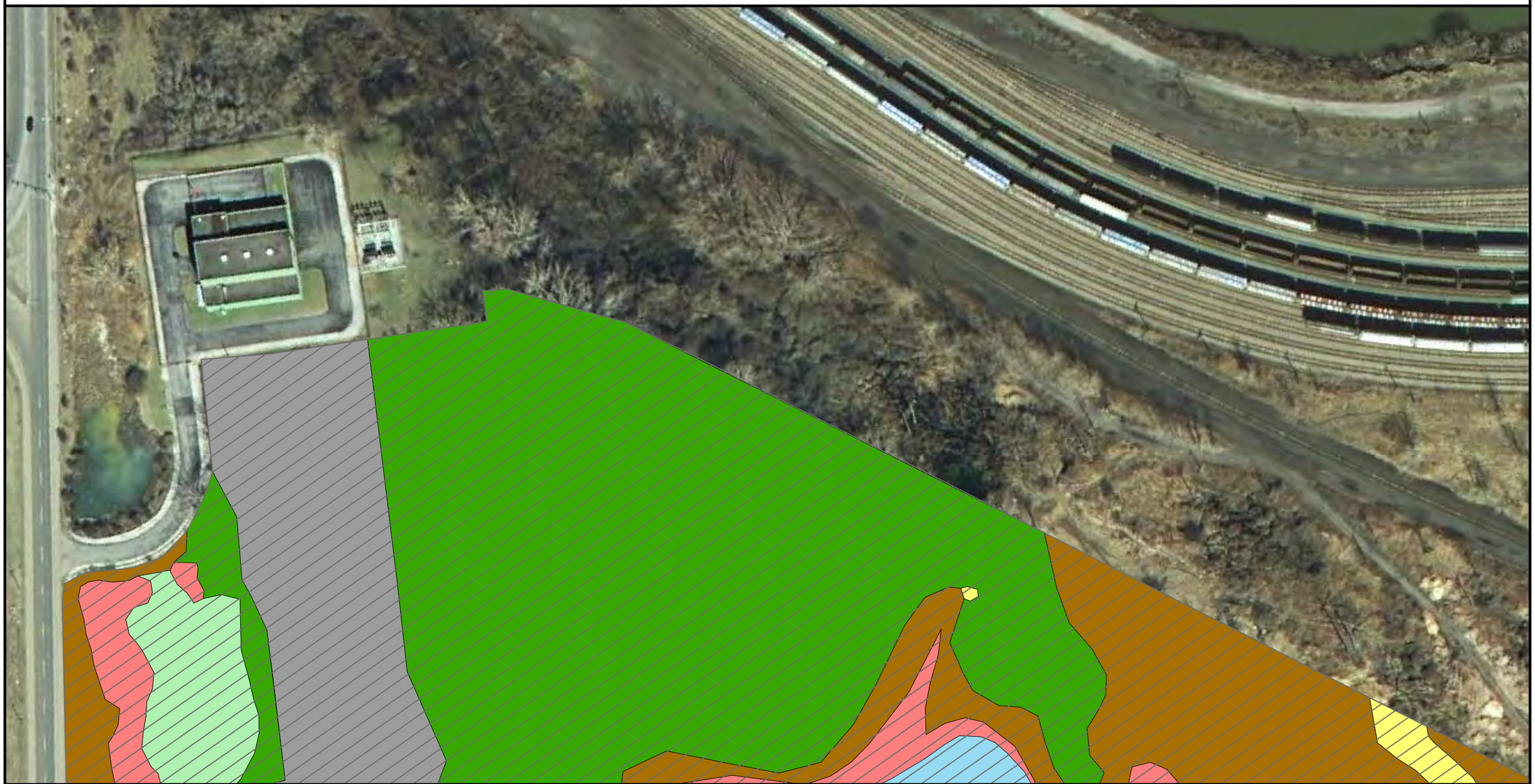
Tifft Cover Type Mapping



N

1 inch = 100 feet

0 50 100 Feet

- Study Area
- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 1 of 11

New York Power Authority

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Tifft Cover Type Mapping

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1 inch = 100 feet

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- Non-Study Area
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- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 2 of 11

New York Power Authority

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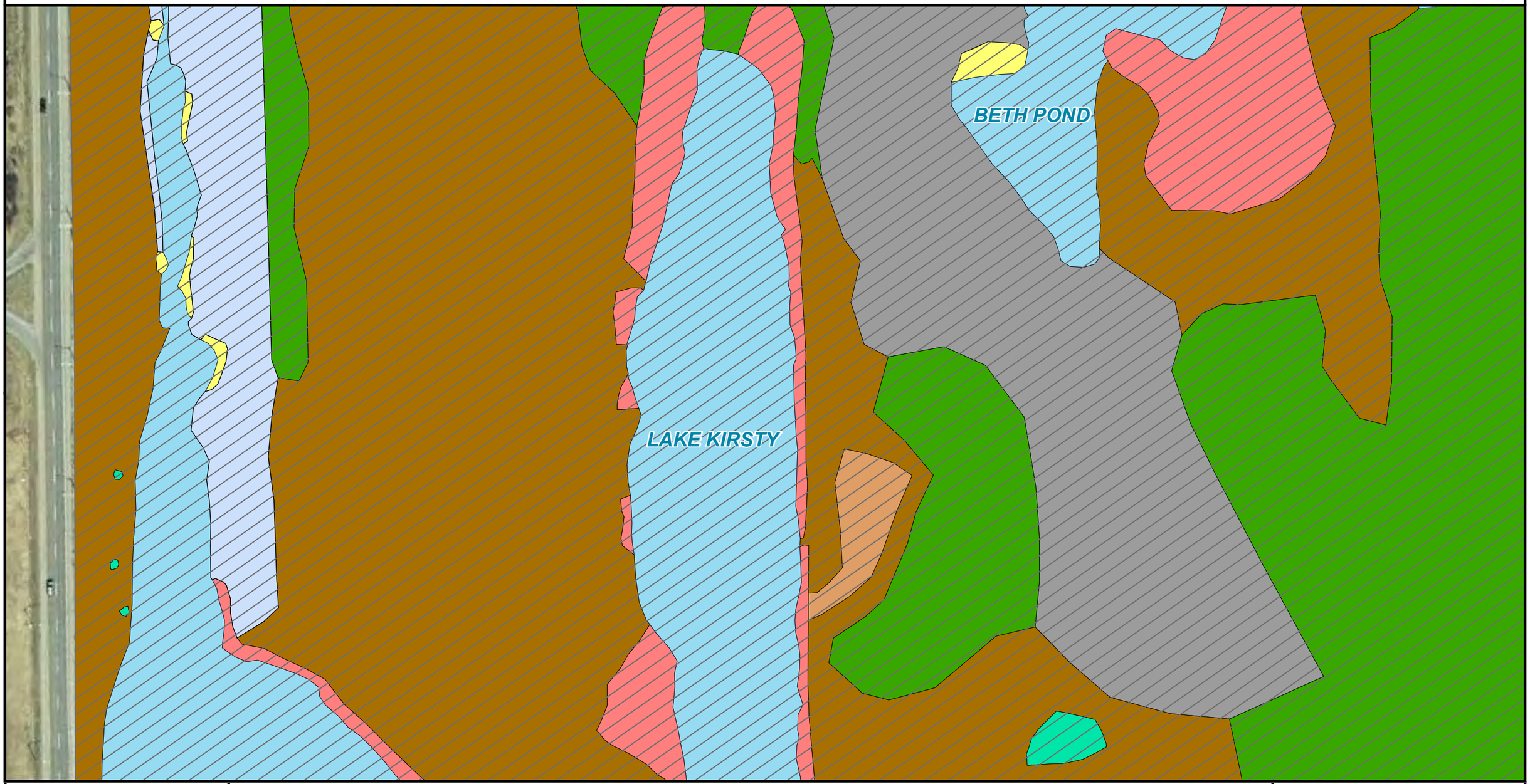

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- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 3 of 11

New York Power Authority

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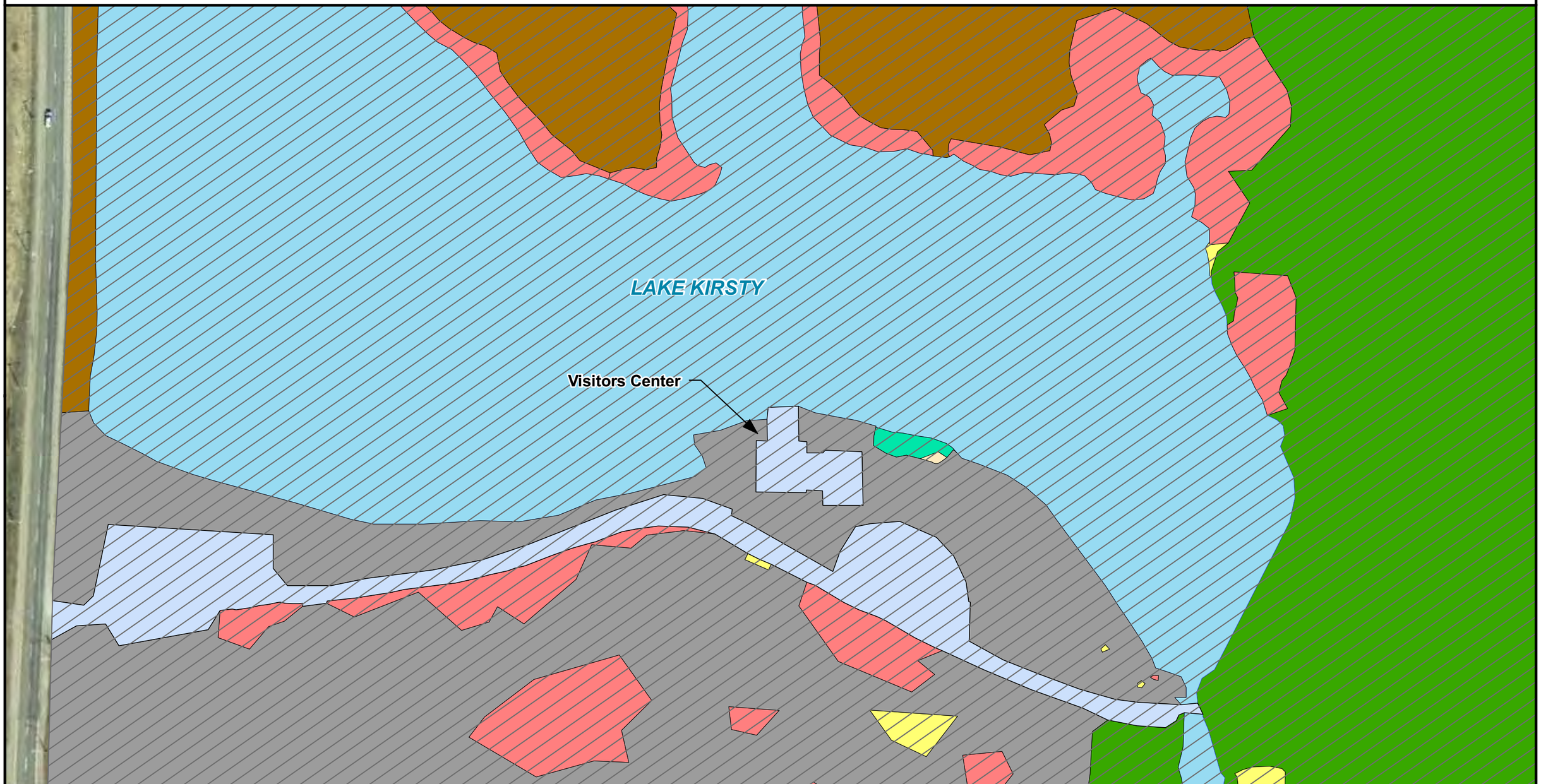

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1 inch = 100 feet

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- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 4 of 11

New York Power Authority

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Tifft Cover Type Mapping

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1 inch = 100 feet

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- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 5 of 11

New York Power Authority

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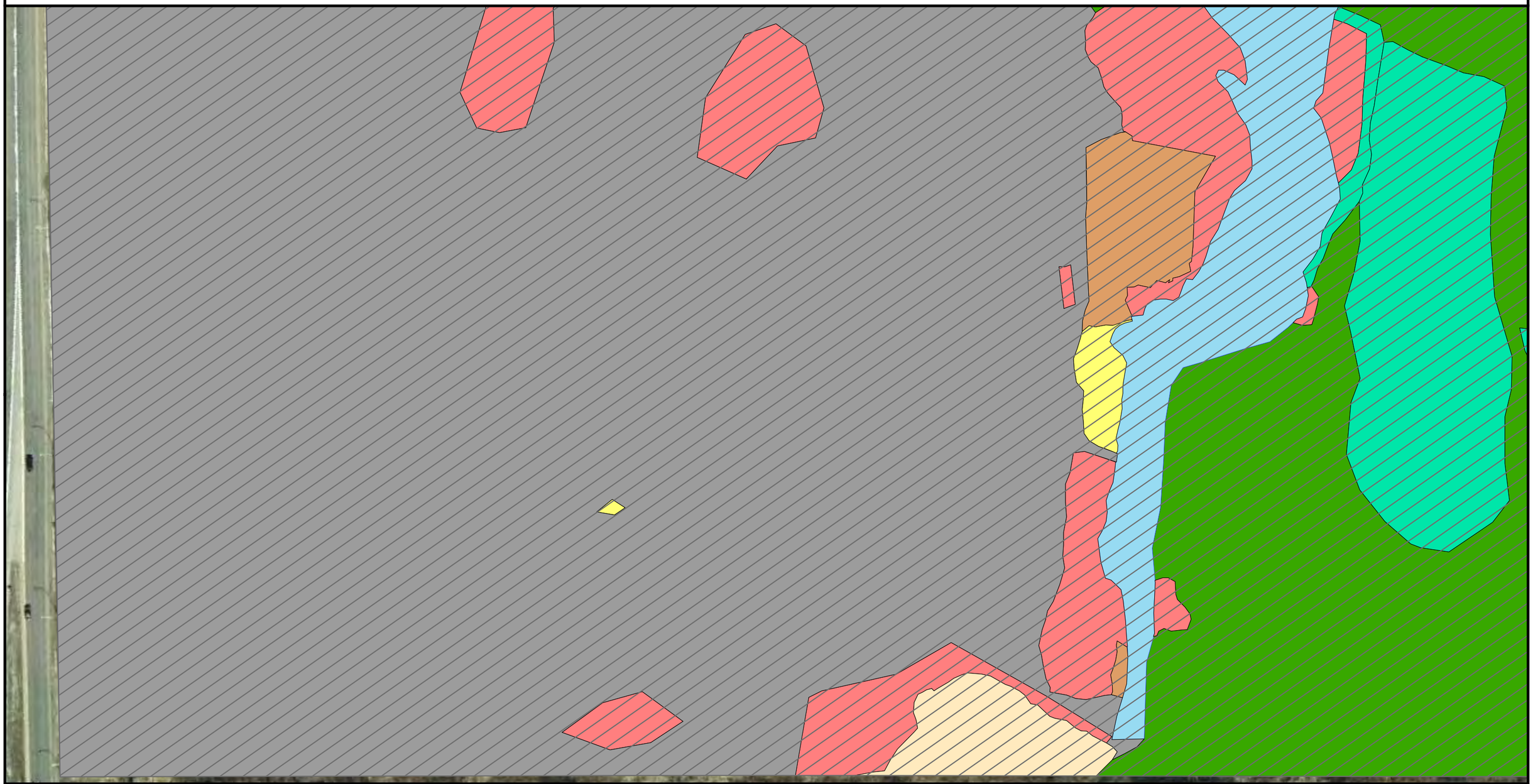

N

1 inch = 100 feet

0 50 100 Feet

Study Area
SHAPE.area
Study Area
Non-Study Area
OPEN WATER
CATTAIL DOMINATED MARSH
COMMON REED DOMINATED MARSH
MIXED SPECIES COMMON REED PRESENT
MIXED SPECIES MARSH DOMINATED BY NATIVES
FORESTED
SCRUB-SHRUB
JAPANESE KNOTWEED
MOWED
UPLAND SHRUB/DISTURBED SOILS
OTHER

Text High Priority
Text Moderate Priority
Text Low Priority

Appendix B.
Sheet 6 of 11

New York Power Authority

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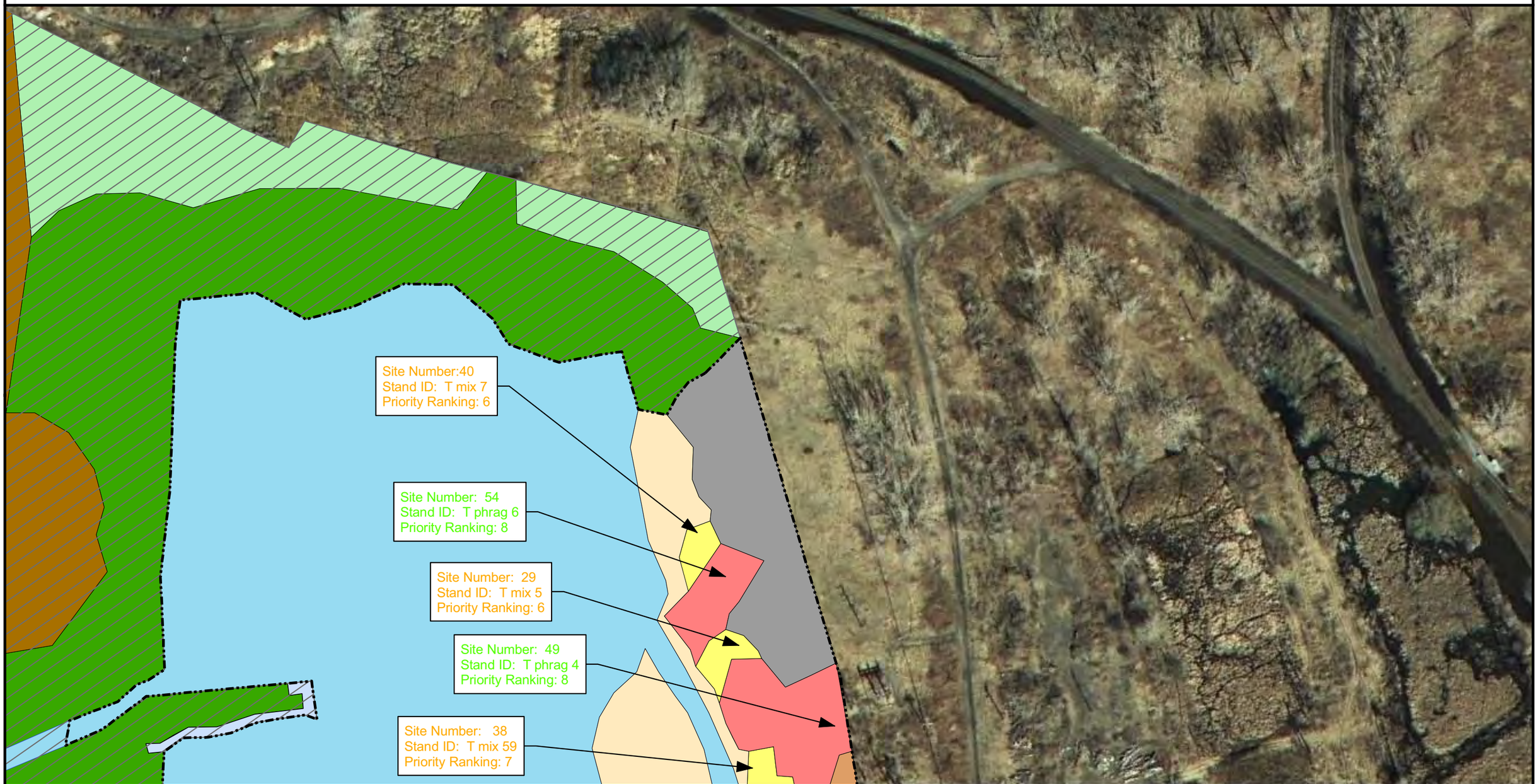

N

1 inch = 100 feet

0 50 100 Feet

- Study Area
- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 7 of 11

New York Power Authority

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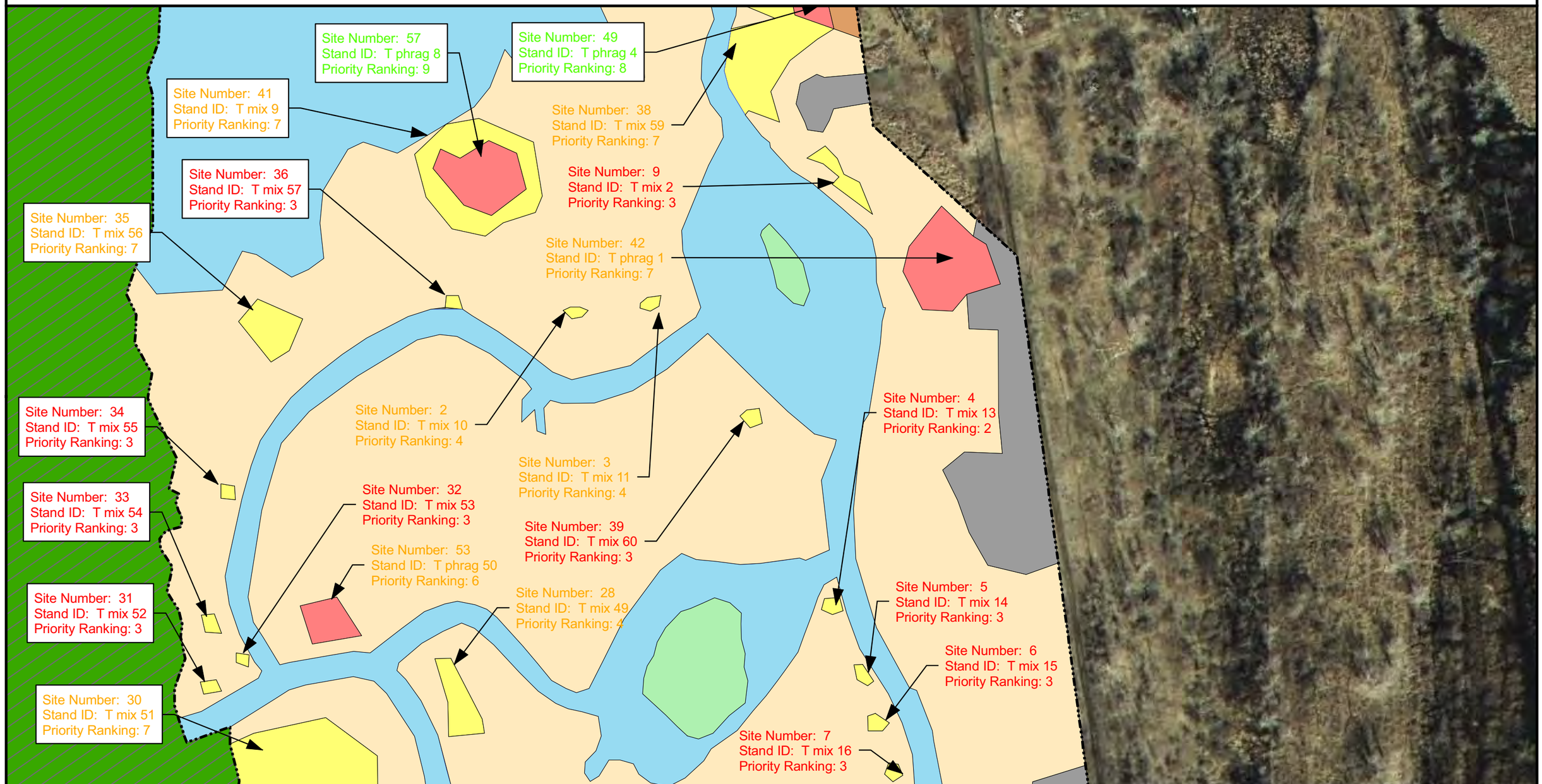

Appendix B.
Sheet 8 of 11

New York Power Authority

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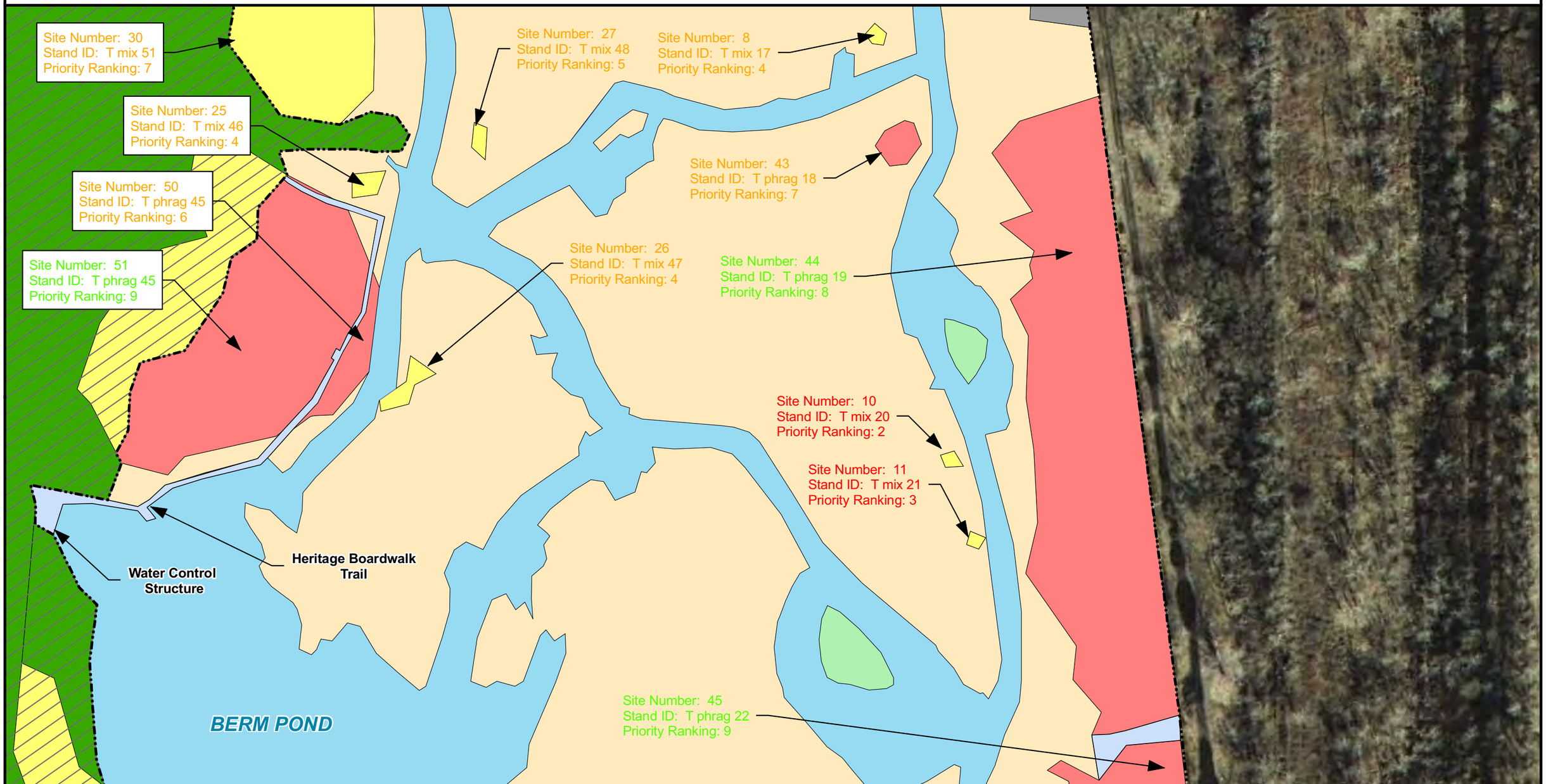

N

1 inch = 100 feet

0 50 100 Feet

Study Area
Non-Study Area
OPEN WATER
CATTAIL DOMINATED MARSH
COMMON REED DOMINATED MARSH
MIXED SPECIES COMMON REED PRESENT
MIXED SPECIES MARSH DOMINATED BY NATIVES
FORESTED
SCRUB-SHRUB
JAPANESE KNOTWEED
MOWED
UPLAND SHRUB/DISTURBED SOILS
OTHER

Text High Priority
Text Moderate Priority
Text Low Priority

Appendix B.
Sheet 9 of 11

New York Power Authority

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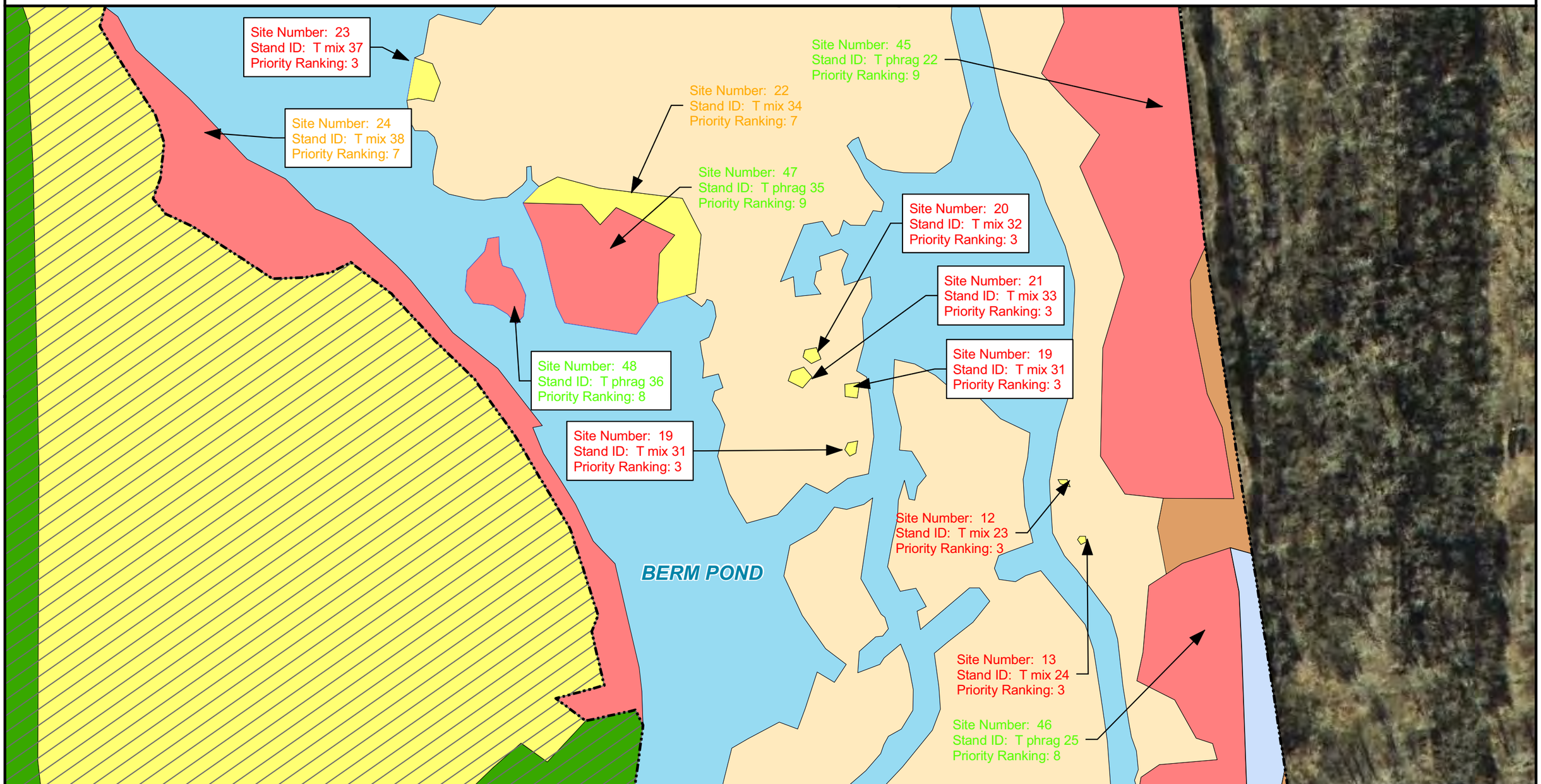

N

1 inch = 100 feet

0 50 100 Feet

- Study Area
- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 10 of 11

New York Power Authority

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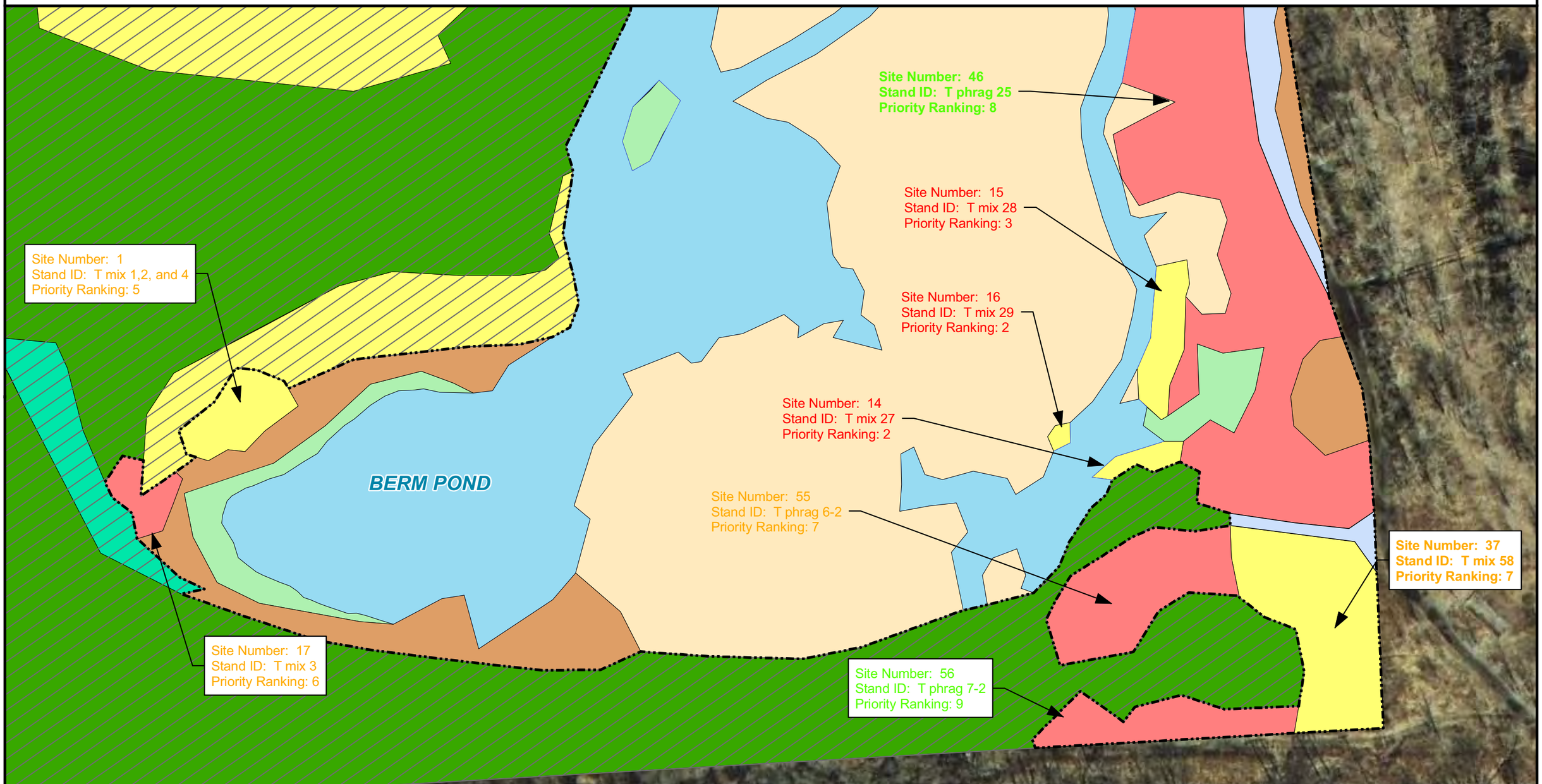

N

1 inch = 100 feet

0 50 100 Feet

- Study Area
- Non-Study Area
- OPEN WATER
- CATTAIL DOMINATED MARSH
- COMMON REED DOMINATED MARSH
- MIXED SPECIES COMMON REED PRESENT
- MIXED SPECIES MARSH DOMINATED BY NATIVES
- FORESTED
- SCRUB-SHRUB
- JAPANESE KNOTWEED
- MOWED
- UPLAND SHRUB/DISTURBED SOILS
- OTHER

Text High Priority

Text Moderate Priority

Text Low Priority

Appendix B.
Sheet 11 of 11

New York Power Authority

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Appendix C: Invasive Species Info

Common reed (*Phragmites australis*)

Common reed is a grass species that ranges across Europe, Asia, Africa, America, and Australia. Over the last 50 years, Common reed has become increasingly prominent in many wetland types throughout the U.S. and, until recently, was considered an exotic species in North America. However, current genetic analysis has identified 27 halotypes, or lineages, of Common reed occurring in North America, 11 of which have been determined to be native (Blossey, 2002b). The remaining halotypes are non-native, being primarily of European ancestry and were likely introduced into North America prior to the 20th century. These non-native lineages have proven to be exceedingly invasive, forming dense, cloned stands that displace diverse assemblages of native wetland vegetation. Halotype M is of European ancestry and appears to be responsible for most invasive occurrences of Common reed in the U.S. In fact, type M has greatly increased in abundance over the past 100 years and has nearly replaced many native halotypes in New England and northeastern United States (Saltonstall, 2002).

Common reed is a perennial grass with stout, hollow, woody culms between 3–20 feet in height (USDA, 2005a). Common reed often forms dense colonial stands with rhizomatous roots. The leaves are flat, long acuminate and between 1/2 to 2 inches m wide and 6 to 8 inches in length. The multiple, branching inflorescence (panicle), or seed head, is between 8 and 16 inches in length with silky hairs along the flowers axis giving the inflorescence a tawny, plume-like appearance (Texas Cooperative Extension, 2007).

The non-native variety of Common reed is an extremely aggressive plant that has the capacity to quickly form monocultures, thereby, out competing native vegetation and altering ecological processes. However, native types of Common reed can be regarded as a stable, natural component of a wetland community. Many native populations of Common reed are "benign" and pose little or no threat to other species and should be left intact. Native versus non-native halotypes can be identified positively through genetic analysis and with some accuracy in the field.

Common reed is a problem when and where stands appear to be spreading while other species typical of the community are diminishing. Disturbances or stresses such as pollution, alteration of the natural hydrologic regime, dredging, and increased sedimentation favor invasion and continued spread of Common reed (Roman *et al*., 1984).

Japanese knotweed (*Polygonum cuspidatum*)

Japanese knotweed is a member of the buckwheat family and a native to Eastern Asia. The growth form of Japanese knotweed is shrub like, growing upright and reaching heights over 10 feet. The stems of Japanese knotweed are smooth and become stout or swollen along joints were the leaves meet the stem. Leaf size is variable; commonly leaves are 6 inches long and 3-4 inches in width. Leaves are broadly oval and sometimes triangular with a pointed tip. Flowers appear greenish white in color and are found in branched sprays in summer. Flowers are followed by small winged fruits (PCA, 2005).

The current distribution of Japanese knotweed includes 36 of the lower 48 states, ranging from Maine to Wisconsin and south to Louisiana. Knotweed is also found scattered throughout the Midwest and western states. It is thought that knotweed was introduced to the United States at some point in the late 1800's. Common names also include Crimson beauty, Mexican bamboo, Japanese fleece flower, or Reynoutria. It was originally introduced as an ornamental shrub with some use as erosion control or landscape screening (PCA, 2005).

Japanese knotweed emerges from underground rhizomes in the early spring after over wintering. Emergence occurs in March or April followed by a period of rapid growth which allows full height to be attained by early summer. In native ranges reproduction is accomplished predominantly by insect pollination, sexual reproduction, and wind dispersal of seed. Introduced populations rely heavily on vegetative reproduction (TNC, 2003). Seeds that are produced by introduced populations rarely germinate in the wild. Knotweed is capable of sprouting from rhizomatic tissue as well as from internodal tissues. Dispersal of knotweed is dependent on transportation of rhizome fragments by way of water or through soils contaminated with rhizomes (Van Driesche 2002).

Japanese knotweed is tolerant of a wide range of conditions including full shade, high temperatures, high salinity, and drought. Commonly it is found near water sources, such as along streams and rivers, in lowlands, waste places, and utility rights-of-way (PCA, 2005). Knotweed has been observed in a variety of soil types including silt, loam, and sand. Generally pH levels ranging from 4.5 to 7.4 are tolerated. Knotweed aggressively spreads after escaping cultivation (Van Driesche, 2002).

Japanese knotweed primarily acts to exclude native plants species by quickly forming dense thickets. These dense thickets shade out native vegetation and offer little value to wildlife. Rhizome systems of knotweed can exceed 15 to 20 meters in length allowing the plant to achieve early emergence and great height in a short amount of time, which results in a shading of natural species and the resultant drop in plant diversity. Knotweed begins to senesce following the first frost and the remaining dead stems create an obstacle that further inhibits native plant regeneration and leaves infested areas vulnerable to erosion. This increased erosion potential acts to facilitate the further spread by exposing rhizomes to flowing waters, which can lead to further infestations (Van Driesche, 2002). Currently, losses due to Japanese knotweed are thought to be substantial, but they have not been quantified. Knotweed often enters wetland habitat and therefore can become a particular concern in these areas.

Glossy & Common Buckthorn (*Rhamnus cathartica* and *Rhamnus frangula*)

Common buckthorn is a shrub or small tree originally introduced from Eurasia as an ornamental. Common buckthorn is a member of the buckthorn family (Rhamnaceae) and commonly grows to 22 feet in height and a diameter of 10”. Bark of the Common buckthorn is grey to brown with rough texturing often confused with that of plum trees. The inner bark is often yellow with the heartwood ranging from pink to orange. Twigs of the Common buckthorn are often tipped with a spine. Leaves tend to be oval with rounded or pointed tips, with 3-4 pairs of up curved veins. Leaves of the Common buckthorn appear glossy green on the upper surface and often remain so late into the fall. Fruiting occurs in the fall in the form of small black fruits. Habitat preferences of the Common buckthorn include open woods, forest

edges, roadsides, prairies, and open fields. It can tolerate a wide range of soil types including well drained or poorly drained sites (USDA, 2005).

Glossy buckthorn is very similar to Common buckthorn in appearance and growth form. Glossy buckthorn was also introduced as an ornamental tree from Eurasia. Glossy buckthorn differs from Common buckthorn in that the leaf margins are toothless with a shiny surface and a dull hairy or smooth lower surface. Fruiting occurs from July to September in the form of red to dark purple pea sized berries. Glossy buckthorn can tolerate a wide range of conditions and is commonly found along river banks, forest edges, lakes sides, and wetlands (USDA, 2006c).

Common and Glossy buckthorn form dense thickets often crowding or shading out native shrubs and herbs. Both Common and Glossy buckthorn grow at rapid rates (Glossy being particularly aggressive in wet areas). In most cases buckthorn thickets can eradicate native vegetation entirely. Glossy buckthorn is a prolific producer of berries that attract birds in tern spreading the seeds further. Currently Common and Glossy buckthorn are present within the non-marsh portion of the preserve. In the vicinity of Lake Kirsty, in particular, large stands of buckthorn are established.

Narrow Leaved Cattail (*Typha angustifolia*)

Narrow-leaved cattail is a member of the cattail family (Typhaceae) and a native of Eurasia. Currently the species is present in 43 of 50 States and frequently hybridizes with the native Broad-leaved cattail (Typha latifolia) to produce cattails that may be difficult to differentiate (*Typha X glauca*).

Similar to broadleaved cattail Narrow-leaved cattail grows to heights of 3-6 feet. Leaves are long, linear, and flattened often reaching lengths of 2-6 feet. Leaves emerge in the spring and

flowers mature in mid summer. Flowers are similar to those of Broad-leaved cattail and are comprised of the female and male flowers. The female flowers appear as velvety brown, cigar-shaped spikes 2-6 inches in length. The male flowers appear above the female flower on the top of the stem and occur as thick brown dense mass that later breaks up allowing the fruits to spread. A defining feature of Narrow-leaved cattail is the presence of a gap between the male and female flowers (which is absent in Broad-leaved varieties).

Narrow-leaved cattail inhabits habitats similar to that of the native Broad-leaved cattail. Generally Narrow-leaved cattail is found in wetlands, along lakeshores and backwaters, ditches, bogs, brackish marshes, lakes, and ponds. Impacts from this species are directly related to it's ability to dominate riparian areas and create a dense rhizome mat that reduces the opportunity for other plants to become established. Often this results in expansive mono-typical stands of Cattail.

Appendix D: Survey Data Sheets

General Plot Information

Observers: SEK, AEH, JDG, GE Date: ___7-16-08__

Plot ID: T-1

Northing: 1039160.4 Easting: 1075840.6

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	38	28
Cattail sp.	*Typha sp.*	38	
Swamp thistle	*Cirsium muticum*	10.5	
Clear weed	*Pilea pumila*	10.5	
Foxtail sedge	*Carex vulpinoidea*	TR	
Soft rush	*Juncus effusus*	TR	
Carex sp.	*Carex sp.*	TR	
Agrostis		TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

Photo: Plot T-1

General Plot Information

Observers: AMP, AEH, GE Date: ___7-16-08__

Plot ID: T-2

Northing: Not Collected Easting: Not Collected

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	85.5	41
Cattail sp.	*Typha sp.*	3.0	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Thick build-up of Common reed thatch within stand.

Photo: Plot T-2

General Plot Information

Observers : AEH, GE Date: ___7-16-08__

Plot ID: T-3

Northing: Not Collected Easting: Not Collected

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	85.5	70
Bittersweet nightshade	*Solanum dulcamara*	TR	
Mint sp.	*Mentha sp.*	3.0	
Horsetail sp.	*Equisetum sp.*	3.0	
Willow sp.	*Salix sp.*	3.0	
Yellow rocket	*Barbarea sp.*	3.0	
Thistle sp. (no flower)	*Cirsium sp.*	TR	
Grape sp.	*Vitis sp.*	TR	
Red oiser dogwood	*Cornus sericea*	TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Long linear phrag stand located along power line ROW.

Photo: Plot T-3

General Plot Information

Observers : SEK, AEH Date: ___7-16-08__

Plot ID: T-4

Northing: 1037053.0 Easting: 1076378.7

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	98	49

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

Photo: Plot T-4

General Plot Information

Observers : AEH, AMP,GE Date: ___7-16-08__

Plot ID: T-5

Northing: 1037387.7 Easting: 1076409.5

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	38.0	19
Cattail sp.	Typha sp.	38.0	17
Unidentified sp. #1		TR	
Unidentified sp. #2		TR	
Marsh purslane	*Ludwigia palustris*	TR	

* For use in monoculture stands (*i.e*. Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: 5” of standing water

Photo: Plot T-5

General Plot Information

Observers : AMP, AEH, GE Date: 7-16-08

Plot ID: T-6

Northing: Not Collected Easting: Not Collected

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Japanese knotweed	*Polygonum cuspidatum*	20.5	28
Cattail sp.	*Typha sp.*	63.0	
False nettle	*Boehmeria cylindrica*	10.5	
Jewelweed	*Impatiens capensis*	3.0	
Skullcap	*Scutellaria sp.*	TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations:

Photo: Plot T-6

General Plot Information

Observers : AMP, AEH, GE Date: ___7-16-08__

Plot ID: T-7

Northing: Not Collected Easting: Not Collected

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	63.0	34
Cattail sp.	*Typha sp.*	38.0	
Jewelweed	*Impatiens capensis*	TR	
False nettle	*Boehmeria cylindrica*	TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Muck soils (all plots except the one under power line ROW).

Photo: Plot T-7

General Plot Information

Observers : AMP, AEH, GE Date: 7-16-08

Plot ID: T-8

Northing: Not Collected Easting: Not Collected

Vegetation Information

Common Name	Scientific Name	Areal Cover Class	Stem Count*
Common reed	*Phragmites australis*	85.5	48
Broad leaf cattail	*Typha sp.*	3.0	
False nettle	*Boehmeria cylindrica*	TR	

* For use in monoculture stands (*i.e.* Phragmites)

Aerial Cover Estimate Mid-Points

1-5%	3.0
6-15%	10.5
16-25%	20.5
26-50%	38.0
51-75%	63.0
76-95%	85.5
96-100%	98.0

Notes/Observations: Muck soils, 100% phrag under willow and cottonwood.

Photo: Plot T-8

GENERAL TIFFT PHOTOS

Photo: View across cattail dominated marsh interior of Tifft.

Photo: View looking toward an area of native Burreed, located at the southern end of the marsh.

Photo: View of a large stand of Japanese knotweed located along the fringe of the southern portion of the marsh.

Photo: View looking along a trail crossing the power line R-O-W to the east of the marsh, note dense Common reed stands on either side of the trail.

Photo: View across Tifft Marsh dominated by Cattail.

Photo: Water control structure for the marsh, located near the southern end of the Heritage Boardwalk.

Appendix E: Prioritization Matrix

Appendix E, Table 1. Individual Stand Ranking Based on Decision Framework Outlined in Section 6

Survey ID	Site Number	Cover Type	Invasive Cover %	Acres	Evaluation Criteria					
					Size	Access	Cover	Expansion	Sens. Hab	Priority Score*
t mix 1, 2, and 4	1	MIXED SPECIES COMMON REED PRESENT	45	0.154	1	1	1	1	1	5
t mix 10	2	MIXED SPECIES COMMON REED PRESENT	5	0.005	0	2	0	0	2	4
t mix 11	3	MIXED SPECIES COMMON REED PRESENT	5	0.006	0	2	0	0	2	4
t mix 13	4	MIXED SPECIES COMMON REED PRESENT	2	0.007	0	1	0	0	1	2
t mix 14	5	MIXED SPECIES COMMON REED PRESENT	2	0.006	0	1	0	0	2	3
t mix 15	6	MIXED SPECIES COMMON REED PRESENT	10	0.007	0	1	0	0	2	3
t mix 16	7	MIXED SPECIES COMMON REED PRESENT	15	0.006	0	1	0	0	2	3
t mix 17	8	MIXED SPECIES COMMON REED PRESENT	48	0.007	0	1	1	0	2	4
t mix 2	9	MIXED SPECIES COMMON REED PRESENT	30	0.026	0	1	0	1	1	3
t mix 20	10	MIXED SPECIES COMMON REED PRESENT	5	0.006	0	1	0	0	1	2
t mix 21	11	MIXED SPECIES COMMON REED PRESENT	5	0.005	0	1	0	0	2	3
t mix 23	12	MIXED SPECIES COMMON REED PRESENT	10	0.001	0	1	0	1	1	3
t mix 24	13	MIXED SPECIES COMMON REED PRESENT	15	0.001	0	1	0	1	1	3
t mix 27	14	MIXED SPECIES COMMON REED PRESENT	30	0.043	0	1	0	3	2	6
t mix 28	15	MIXED SPECIES COMMON REED PRESENT	30	0.125	1	1	0	3	2	7
t mix 29	16	MIXED SPECIES COMMON REED PRESENT	15	0.011	0	1	0	0	1	2
t mix 3	17	COMMON REED DOMINATED MARSH	75	0.081	0	1	2	2	1	6
t mix 30	18	MIXED SPECIES COMMON REED PRESENT	15	0.003	0	1	0	0	2	3
t mix 31	19	MIXED SPECIES COMMON REED PRESENT	15	0.005	0	1	0	0	2	3
t mix 32	20	MIXED SPECIES COMMON REED PRESENT	20	0.005	0	1	0	0	2	3
t mix 33	21	MIXED SPECIES COMMON REED PRESENT	20	0.008	0	1	0	0	2	3
t mix 34	22	MIXED SPECIES COMMON REED PRESENT	60	0.167	1	2	1	1	2	7
t mix 37	23	MIXED SPECIES COMMON REED PRESENT	15	0.026	0	1	0	0	2	3
t mix 38	24	COMMON REED DOMINATED MARSH	75	0.912	2	0	2	1	2	7
t mix 46	25	MIXED SPECIES COMMON REED PRESENT	20	0.017	0	0	0	2	2	4
t mix 47	26	MIXED SPECIES COMMON REED PRESENT	25	0.026	0	1	0	1	2	4
t mix 48	27	MIXED SPECIES COMMON REED PRESENT	35	0.01	0	1	1	0	2	4
t mix 49	28	MIXED SPECIES COMMON REED PRESENT	25	0.05	0	1	0	1	2	4

Appendix E, Table 1. Individual Stand Ranking Based on Decision Framework Outlined in Section 6 (Cont'd)

Survey ID	Site Number	Cover Type	Invasive Cover %	Acres	Evaluation Criteria					
					Size	Access	Cover	Expansion	Sens. Hab	Priority Score*
t mix 51	30	MIXED SPECIES COMMON REED PRESENT	50	0.554	2	0	1	2	2	7
t mix 52	31	MIXED SPECIES COMMON REED PRESENT	5	0.005	0	1	0	0	2	3
t mix 53	32	MIXED SPECIES COMMON REED PRESENT	5	0.003	0	1	0	0	2	3
t mix 54	33	MIXED SPECIES COMMON REED PRESENT	5	0.007	0	1	0	0	2	3
t mix 55	34	MIXED SPECIES COMMON REED PRESENT	10	0.005	0	1	0	0	2	3
t mix 56	35	MIXED SPECIES COMMON REED PRESENT	70	0.057	0	2	1	2	2	7
t mix 57	36	MIXED SPECIES COMMON REED PRESENT	4	0.005	0	1	0	0	2	3
t mix 58	37	MIXED SPECIES COMMON REED PRESENT	45	0.516	2	0	1	3	2	8
t mix 59	38	MIXED SPECIES COMMON REED PRESENT	45	0.187	1	0	1	3	2	7
t mix 60	39	MIXED SPECIES COMMON REED PRESENT	2	0.007	0	1	0	0	2	3
t mix 7	40	MIXED SPECIES COMMON REED PRESENT	50	0.04	0	0	1	3	2	6
t mix 9	41	MIXED SPECIES COMMON REED PRESENT	33	0.162	1	1	1	2	2	7
t phrag 1	42	COMMON REED DOMINATED MARSH	90	0.157	1	0	2	3	1	7
t phrag 18	43	COMMON REED DOMINATED MARSH	85	0.035	0	1	2	2	2	7
t phrag 19	44	COMMON REED DOMINATED MARSH	98	1.623	2	0	2	3	1	8
t phrag 22	45	COMMON REED DOMINATED MARSH	98	1.417	2	0	2	3	2	9
t phrag 25	46	COMMON REED DOMINATED MARSH	95	1.942	2	1	2	3	2	10
t phrag 35	47	COMMON REED DOMINATED MARSH	98	0.329	1	1	2	3	2	9
t phrag 36	48	COMMON REED DOMINATED MARSH	75	0.072	0	1	2	3	2	8
t phrag 4	49	COMMON REED DOMINATED MARSH	95	0.303	1	0	2	3	2	8
t phrag 45	50	COMMON REED DOMINATED MARSH	90	0.075	0	0	2	2	2	6
t phrag 45	51	COMMON REED DOMINATED MARSH	90	0.946	2	0	2	3	2	9
t phrag 45	52	COMMON REED DOMINATED MARSH	90	0.003	0	0	2	3	2	7
t phrag 50	53	COMMON REED DOMINATED MARSH	75	0.046	0	1	2	1	2	6
t phrag 6	54	COMMON REED DOMINATED MARSH	80	0.131	1	0	2	3	2	8
t phrag 6-2	55	COMMON REED DOMINATED MARSH	75	0.385	1	0	2	3	2	8
t phrag 7-2	56	COMMON REED DOMINATED MARSH	75	0.221	1	1	2	3	2	9
t phrag 8	57	COMMON REED DOMINATED MARSH	85	0.11	1	2	2	2	2	9

* Priority Score = (Size+Access+Cover+Expansion+Sens. Hab.)

Appendix E, Table 2. Group Ranking of Invasive Species Polygons

Stand ID	Site Number	Group	Group Rank	Priority	Acres
High Priority Sites (Phase 1)					
t mix 23	12	13	2.66	High	0.001
t mix 24	13	13	2.66	High	0.001
t mix 29	16	13	2.66	High	0.011
t mix 13	4	5	3.00	High	0.007
t mix 14	5	5	3.00	High	0.006
t mix 15	6	5	3.00	High	0.007
t mix 16	7	5	3.00	High	0.006
t mix 17	8	5	3.00	High	0.007
t mix 60	39	5	3.00	High	0.007
t mix 20	10	6	4.00	High	0.006
t mix 21	11	6	4.00	High	0.005
t phrag 18	43	6	4.00	High	0.035
t mix 10	2	2	4.60	High	0.005
t mix 11	3	2	4.60	High	0.006
t mix 46	25	8	4.60	High	0.017
t mix 47	26	8	4.60	High	0.026
t mix 52	31	2	4.60	High	0.005
t mix 53	32	2	4.60	High	0.003
t mix 54	33	2	4.60	High	0.007
t mix 55	34	2	4.60	High	0.005
t mix 56	35	2	4.60	High	0.057
t mix 57	36	2	4.60	High	0.005
t mix 9	41	2	4.60	High	0.162
t phrag 45	50	8	4.60	High	0.075
t phrag 8	57	2	4.60	High	0.11
t mix 48	27	4	4.66	High	0.01
t mix 49	28	4	4.66	High	0.05
t phrag 50	53	4	4.66	High	0.046
t mix 30	18	9	4.88	High	0.003
t mix 31	19	9	4.88	High	0.005
t mix 32	20	9	4.88	High	0.005
t mix 33	21	9	4.88	High	0.008
t mix 34	22	9	4.88	High	0.167
t mix 37	23	9	4.88	High	0.026
t phrag 35	47	9	4.88	High	0.329
t phrag 36	48	9	4.88	High	0.072
				High Priority Sub-Total	**1.30**

Appendix E, Table 2. Group Ranking of Invasive Species Polygons (Cont'd)

Stand ID	Site Number	Group	Group Rank	Priority	Acres
Moderate Priority Sites					
t mix 1, 2, and 4	1	11	5.50	Moderate	0.154
t mix 3	17	11	5.50	Moderate	0.081
t mix 2	9	1	6.43	Moderate	0.026
t mix 5	29	1	6.43	Moderate	0.05
t mix 59	38	1	6.43	Moderate	0.187
t mix 7	40	1	6.43	Moderate	0.04
t phrag 1	42	1	6.43	Moderate	0.157
t phrag 4	49	1	6.43	Moderate	0.303
t phrag 6	54	1	6.43	Moderate	0.131
t mix 38	24	10	7.00	Moderate	0.912
t mix 51	30	3	7.00	Moderate	0.554
				Moderate Priority Sub-Total	**2.60**
Low Priority Sites					
t mix 27	14	12	8.00	Low	0.043
t mix 28	15	12	8.00	Low	0.125
t mix 58	37	12	8.00	Low	0.516
t phrag 25	46	12	8.00	Low	1.942
t phrag 45	51	7	8.00	Low	0.946
t phrag 45	52	7	8.00	Low	0.003
t phrag 6-2	55	12	8.00	Low	0.385
t phrag 7-2	56	12	8.00	Low	0.221
t phrag 19	44	14	8.50	Low	1.623
t phrag 22	45	14	8.50	Low	1.417
				Low Priority Sub-Total	**7.22**
				Grand Total	**11.12**